Chapter 3 • Affected Environment and Environmental Consequences

This chapter describes the existing conditions and environmental effects associated with the Proposed Action and alternatives, including the No Action Alternative. There are 13 resource sections. Each section begins by describing the affected environment, which is then followed by an assessment of the expected consequences from implementing the Proposed Action and alternatives. Each section summarizes some of the more detailed information from the technical analysis reports prepared for this project in order to make the information readily understood and reduce the length of this EIS. The individual analysis reports are in the project record and available for public review. Where there are differences between the information contained in the analysis reports and the information in this EIS, the EIS takes precedence. The EIS was reviewed and edited by various BLM, FS, and consultants several times throughout the interdisciplinary process after the original reports were written.

Considerations for Cumulative Effects

Discussions of cumulative effects for each resource are provided at the end of each resource section. Evidence is increasing that serious environmental effects can result not just from the direct effects of a particular project, but from the combination of individually minor effects of multiple projects over time. Some authorities contend that most environmental effects should be seen as cumulative because almost all systems have already been modified, even degraded by humans (CEQ 1997).

The CEQ regulations implementing the procedural provisions of the National Environmental Policy Act define cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions" (40 Code of Federal Regulations [CFR] Part 1508.7). The regulations further explain "cumulative effects can result from individually minor but collectively significant actions taking place over a period of time." The cumulative effects analysis presented in each resource section is based on the potential effects of the Buckman Project added to past, present, and reasonably foreseeable future actions and their effects in the regions of influence for each resource category.

Past and present land use activities help define the existing conditions for each resource and are, therefore, reflected in the affected environment sections. Past projects that have most noticeably changed the characteristics of the river and river resources in the project area include the following:

- BOR in 1938, as part of the Middle Rio Grande Project, completed construction of El Vado Dam and Reservoir on the Rio Chama. It is owned by Middle Rio Grande Conservancy District (MRGCD) and operated by agreement with BOR. Native waters stored and then released from El Vado are subject to provisions of the Rio Grande Compact. Angostura Diversion Dam, Isleta Diversion, and San Acacia Diversion Dam were also components of the Middle Rio Grande Project.
- Congress authorized the San Juan-Chama Project in 1956 under the Boulder Canyon Project Act. The San Juan-Chama Project consists of facilities that divert water from the San Juan Basin (Colorado River Basin) in southern Colorado through 26 miles of tunnels

beneath the Continental Divide to Willow Creek, a tributary of the Rio Chama in the Rio Grande Basin, in New Mexico.

- The U.S. Army Corps of Engineers (USACE) completed construction of Abiquiu Dam and Reservoir in 1963 and Cochiti Dam in 1970. Both dams influence the characteristics of the Rio Grande.
- The Supplemental Well Project added five new wells in the City of Santa Fe's Buckman Well Field. The well field consists of the original eight wells, plus a ninth that was brought online in April 2003, and four others that were added in late 2003.
- The Buckman area has been modified due to the expansion of the City of Santa Fe, housing, construction, road development, and the demand from an increasing population for more recreational opportunities.

Examples of foreseeable future projects are listed below:

- The City is considering the lease of 3,000 ac-ft/yr of San Juan-Chama Project water from the Jicarilla Apache Nation for an approximately 50-year period ending in 2057. That lease would involve the release of Jicarilla Apache Nation water from Heron Reservoir for use within the City's Water Utility Service System or for regulatory compliance associated with the City's Water Utility Service System, including pumping offsets. The City intends to lease and use that water regardless of the Buckman Project, and to construct the Buckman Project regardless of whether it enters that lease. Neither action depends on the other to achieve its purpose. Because the lease action would be separate and independent of the Buckman Project the lease would be reviewed under a separate environmental compliance process. The Bureau of Reclamation, which has approval authority over the lease delegated from the Secretary of the Interior, would conduct the NEPA process.
- The City of Albuquerque is constructing a diversion for as much as 94,000 ac-ft/yr (47,000 ac-ft/yr of San Juan-Chama water and 47,000 ac-ft/yr of native Rio Grande water) to fully consume their San Juan-Chama water, with the native Rio Grande water returned after treatment at the Southside Water Reclamation Plant. This project includes: construction and operation of a surface WTP to provide potable water for municipal and industrial use; construction of transmission pipelines to convey potable surface water to the city's water service area; continued use of ground water pumped from city wells during periods of drought and to meet peak demands; development of a program to demonstrate and implement aquifer storage and recovery technologies at appropriate city well fields; and use of vested and native surface water rights to offset pumping effects on river flows. A DEIS was published in June 2002 followed by a final EIS on March 5, 2004 and ROD on June 1, 2004.
- The City of Española has proposed a Drinking Water Project that would entail the diversion of 1,000 ac-ft/yr of San Juan-Chama water and approximately 1,000 ac-ft/yr of native water. The diversion would be built on city owned property just north of the city and a portion of the construction work would include upgrades to Los Vigiles Ditch north to the Rio Grande. The San Juan-Chama water would be consumed and the native water would re-enter the Rio Grande at the wastewater treatment plant outfall. An environmental assessment is currently under preparation.
- Los Alamos and the Pueblo of San Ildefonso are considering diverting Rio Grande water, and there may be other projects similar to the Buckman Project that would divert San

Juan-Chama and native waters from the Rio Grande. San Ildefonso installed a single unit infiltration collector well as a pilot project in 2001.

- There is an ongoing cooperative effort between several agencies to identify, fund, implement, and monitor river restoration projects.
- Projects within the Buckman area could include granting of access ROWs for private inholdings within BLM lands, and increased housing development.
- PNM's Project Power has identified three alternatives to upgrade the high-voltage electric transmission system that serves Santa Fe and Las Vegas and preserve electric reliability for area customers past 2004. BLM will be acting as the lead agency on the Project Power effort.
- Other projects may be undertaken related to habitat in the Rio Grande for the silvery minnow, downstream of Cochiti Reservoir.
- The City and County are establishing relationships with other entities responsible for the use and management of the river and are active participants in workgroups and restoration activities, both planned and ongoing.
- Future changes in the Rio Grande could also be related to litigation settlement agreements, collaborative programs, and future legislation. These may include a settlement on the Aamodt et al. litigation that could provide for resolution of water rights in accordance with certain requirements. A settlement of this case could potentially result in the development of a regional water system to serve the Pojoaque Basin that would reduce the impact of domestic wells on the ground water, as well as increase reliance on surface water flows.

Land Tenure and Use

Affected Environment

The area of potential effect for land tenure and use is generally defined as the Buckman and Dead Dog Leg corridors, as well as adjacent lands that are similar in quality and usage to the project area lands. Land tenure and use was evaluated along the Buckman Road/Dead Dog Leg corridors where construction activities for the diversion facilities are proposed. The land for the City and County and Las Campanas has already been zoned for this use.

Within the area of potential effect, land is either administered, owned, or managed by eight different jurisdictions: FS, BLM, Las Campanas, City, County, State of New Mexico, New Mexico Department of Transportation, and private ownership of approximately 265 lots. From the bank of the Rio Grande to approximately 1 mile east of the riverbank, the land belongs to the Santa Fe National Forest administered by the FS. With the exception of a small portion of State land between Las Campanas and FS lands, for the next 17 miles, the land along the Buckman Road/Dead Dog Leg corridors is under BLM jurisdiction. Approximately 3 miles of pipeline corridor and the Las Campanas WTP would be located on property owned by Las Campanas. Within the project area, the FS's Santa Fe National Forest Plan and the BLM's Taos Resource Area's Resource Management Plan specify approved land uses on Federal lands. The City and County would apply for ROW permits with the State of New Mexico and the New Mexico State Highway and Transportation Department. Additionally, easements through private property must

be secured. The County has jurisdiction to approve the pipeline ROW along most of Caja del Rio Road.

Indian Trust Assets or resources are defined as legal interests in assets held in trust by the U.S. Government for Indian tribes or individual tribal members. There are no Indian Trust lands or assets within the potential effect area. The nearest tribal lands belonging to San Ildefonso Pueblo are located directly across the Rio Grande from the proposed diversion structure and sediment facility ponds and well north of the associated roadway and pipeline corridors.

Land uses in the area are varied. Designated land uses include private ranches, timber harvesting for firewood and small wood products such as vigas, latillas, posts and poles, utility corridors and easements, water management (i.e., booster stations, drainages and flood control), rangeland/agriculture, and recreation/open space. The banks of the Rio Grande, within the proposed location for the diversion structure, were prehistorically and are currently used for hunting, fishing, and gathering activities.

The FS and BLM have established long-term cattle grazing allotments within and adjacent to the project area. Cattle movement and distribution are controlled throughout the area by fencing and use of cattle guards. Between Booster Stations 2 and 3, there is a small system of corral fences, associated cattle loading chute, and a small livestock well named Dead Dog Well. The Dead Dog Well location is the site of the only cattle gate on roadways within the project corridors. Grazing lands are characterized by the plant communities as described in the section, “Terrestrial Communities, Affected Environment” later in this chapter.

Currently, there are several existing ROWs issued along the Buckman Road/Dead Dog Leg corridor that include:

- Qwest buried fiber optic line;
- City of Santa Fe water wells, booster stations, surge tanks, and buried water pipelines;
- PNM buried natural gas pipelines; and
- Power lines (both 12.47 kV buried power lines and above ground 115 kV transmission lines).

These ROWs meander back and forth across Buckman Road and Dead Dog Leg Road as they traverse the terrain.

The City owns and operates the Buckman Well Field located near the terminus of Buckman Road on BLM and FS land. The lands where the wells are located are leased by the City from both the BLM and FS. The Buckman Wells, which divert a portion of the City and County’s San Juan-Chama contract water, pump piped water upslope along the Buckman corridor into the municipal supply system.

Booster Station 1 is located within the vicinity of the Buckman Well Field. Booster Stations 2, 3, and 4 are also along the corridor. Each of these stations pumps water from an adjacent surge tank to the next station’s tank southeast and upslope along the corridor. Booster Station 4 is located within Las Campanas. Water is delivered to Las Campanas at two points between Booster Stations 3 and 4. From Booster Station 4, water is pumped into the 10 million gallon tank where it is fluoridated, disinfected, and discharged into the City’s distribution system. At Dead Dog Well, a maintenance road along the Dead Dog Leg corridor continues south-southeast on BLM and

State land between Las Campanas and FS lands. No improved roads intersect the Dead Dog Leg corridor, and usage of this road is light.

Buckman Road functions as a maintenance and recreational access road through the Buckman corridor. According to the Buckman Roadway Study Report (Tierra Lopezgarcia Group, 2004), Buckman Road is classified as a "local lane" according to the Santa Fe County Road ordinances which states "…A local lane, place or cul-de-sac serves 0 to 30 dwelling units or lots and carries an average daily traffic volume of 0 to 300 vehicles with two (2), ten (10) foot driving lanes with a minimum right-of-way of fifty (50) feet…" The road report also states that in accordance with AASHTO criteria, Buckman road could be classified as a "special purpose road." Roads in this category are typically lightly traveled and operate at low speeds. Superelevation of horizontal curves would need to be carefully considered under this classification. No ROW has been issued for Buckman Road. Buckman Road is maintained by the County, and maintenance includes blading and contouring. There are no other improved roads that intersect the unimproved 9.2-mile segment. Unimproved roads exist which diverge from the main trunk of Buckman Road; however, these roads primarily serve as recreational access corridors to the surrounding hills. In some cases, these primitive roads and trails continue onto FS lands. Vehicle use on these roads within FS lands is illegal. The portion of Buckman Road that crosses FS lands is classified as a "Level 2" road, which means it is maintained for high clearance vehicles with passenger car use not intended. The improved segment of Buckman Road, which passes through Las Campanas, has several improved roads that primarily access residential developments around and within Las Campanas.

Prime farmland is defined as land being suitable for the production of any food, feed, fiber, forage, and oilseed crops, and is designated by soil type (BOR/City of Albuquerque 2002). No designated prime or unique farmlands are identified within the Buckman Road/Dead Dog Leg corridors.

Land use activity levels along the Buckman corridor were determined based on traffic survey data collected between August 27 and October 7, 2002. On August 27 (Tuesday) and September 15 (Sunday), traffic surveys of vehicles and occupants on Buckman Road just north of Dead Dog Well were conducted. Observation data that was collected from 10:00 a.m. until 7:00 p.m. included direction of travel, vehicle license plate state of origin, number of people in vehicle, purpose of visit, type of activity (hiking, biking, climbing, etc.), or maintenance/grazing allotment access, and general observations. On Tuesday, there were 22 vehicles with a total of 37 occupants. Twenty vehicle occupants were there for recreational purposes, and 17 people were on work assignments. On Sunday, there were 48 vehicles with 95 occupants, and only 4 people were there on work assignments. On September 9, 2002, a mechanical vehicle counter was buried within and across Buckman Road at a location just north of Dead Dog Well and extracted on October 7, 2002. During this time period the vehicle counter recorded the number of all vehicles using this stretch of Buckman Road. Average weekend use was 99 vehicles over a period of 5 weekends and 96 vehicles during the workweek (Monday through Friday) over a 4-week period (Tetra Tech 2002).

Environmental Consequences

No Action Alternative

The No Action Alternative would leave the land tenure in the Buckman Road/Dead Dog Leg corridors in its current condition. The corridors would continue to be utilized for the existing infrastructure and utilities ROW. Current land uses under the management of the FS, BLM, Las Campanas, City and County of Santa Fe, New Mexico State Highway and Transportation Department, and private parties, would not be affected.

Direct and Indirect Effects of the Proposed Action

Construction Effects. Construction would not affect the operations of existing infrastructure and utilities that occupy the Buckman Road/Dead Dog Leg corridors. However, disturbance of land (e.g., for digging of trenches to pipelines) adjacent to the existing ROW has the potential of causing short-term disruption to the normal maintenance of facilities in the corridors. The construction contractor would minimize such disruptions by having direct contacts with other utility operators and coordinating respective construction and maintenance activities. Buckman Road functions as a maintenance and recreational road through the Buckman corridor. The proposed improvement of this road as needed by the project would also result in temporary and short-term disruptions to vehicular traffic. These disruptions would be minimized by the use of normal traffic control devices and road bypasses where necessary. The treated water pipeline would be constructed mostly on Las Campanas private land and lands running beneath Las Campanas Drive. Thus, some private lands would require utility easements. Paving of Las Campanas Drive would occur prior to implementation of the Buckman Project. Additionally, construction of the pipeline beneath Las Campanas Drive would result in traffic disruption and require repaving of Las Campanas Drive. The north end of this pipeline would run across BLM land in a new ROW for a distance of a half mile.

Short-term disturbance to grazing lands and cattle distribution may occur within the project area due to construction activities. Prior to construction, all grazing permittees would be notified as to the construction schedule and type of construction activities to be conducted within their grazing allotment. Avoidance of undisturbed grazing lands would be the main construction strategy. While construction activity may occur during the scheduled grazing periods, activities would be primarily limited to existing rights-of-way, thus limiting impacts to surrounding grazing lands. Any fences, gates, or cattle guards damaged or removed during construction would be repaired or replaced as necessary to prevent cattle trespass onto adjacent lands.

The proposed construction of a new PNM substation in the NW ¼ of Section 22 under the Proposed Action will have a slight direct effect on grazing. The location of the proposed substation would effectively remove 2 acres of land from one grazing lease. The current grazing lease, on lands including the subject 2-acre substation site, is held by New Mexico State University. As a result of substation construction, New Mexico State University would effectively lose the use of 2 acres of grazing land held as part of the original grazing lease.

The FS's Forest Plan would require special use permits to include new facilities on its land should the Proposed Action go forward. BLM lands in the Buckman Road corridor are currently utilized for a booster station and raw water pipeline belonging to the Buckman Water Management Unit of the City's water well system. Additional booster stations and pipelines to be constructed under

the Proposed Action would require a ROW from the BLM. Construction of a new pipeline in the Dead Dog Leg corridor and a joint City and County WTP at the site of the City's MRC would occupy ROW land granted by the BLM. Las Campanas, a master planned real estate development, has already accounted for the location of the pipeline corridor and a WTP on its land. The City and County of Santa Fe land use requirements are governed by zoning ordinances and have existing utility ROWs. Each of these entities are signatories to a memorandum of understanding and have agreed to coordinate and work cooperatively regarding land use requirements. Construction of facilities would result in temporary as well as permanent disturbance of land. A total of 306 acres of land would be affected, of which 247 acres of land would be temporarily disturbed during construction and would be returned to its pre-construction condition with the area revegetated according to approved vegetation plans after construction is completed. Because the proposed facilities are approved under existing management plans and agreements, and most of the land disturbance would occur along existing utility corridors where current land use is similar to the proposed land use, there would be minimal effects to land tenure and use. Short-term disruptions to maintenance of existing utilities would be minimized through coordination between the construction contractor and the utility operators, thus there would be little affect to infrastructure or utilities.

Operation Effects. Preliminary estimates from PNM indicate that power loads on the existing electrical supply infrastructure near the proposed MRC WTP and along the Buckman Road corridor are nearing capacity. PNM already plans to upgrade infrastructure along Caja del Rio Road sometime in the near future. However, the construction of the proposed MRC WTP would require the construction and operation of a substation adjacent to the MRC WTP.

The operation of a new PNM substation in the NW ¼ of Section 22 under the Proposed Action will have a slight direct effect on grazing. Operation of the proposed substation would remove 2 acres of land from a grazing lease held by New Mexico State University. The 2 acres would be removed in perpetuity to be used by PNM for operation of a new substation next to the proposed MRC WTP. As a result of substation operation, New Mexico State University would effectively lose the use of 2 acres of grazing land held as part of the original grazing lease.

Reliability of the water supply to the City, County, and Las Campanas would be enhanced with the availability of more than one pipeline in the event of an accidental disruption of supply in one of the pipelines. Reliability of the water system would also be enhanced by the construction of additional electrical supply facilities that would make the system less susceptible to power supply related problems. The agreements made by various jurisdictions during project construction would remain in force during project operations. Of the 306 acres of total land disturbed during the construction phase, 247 acres would be restored to its pre-construction condition, leaving 59 acres of permanently converted land for project related uses. Lands permanently occupied by the project-related uses would include the diversion structure with the low-head pump station, booster stations, two WTPs, and power upgrades and road improvements. The land used by the construction of these structures would not be available for any other use (i.e., the land used for the WTP at MRC would no longer be available for recreational use). Minor losses of gazing lands would occur from Buckman Road improvements and land occupied by new facilities. The portion of Buckman Road crossing National Forest System lands would receive minimal improvements under the proposed action so that the maintenance level would remain as a "Level 2" road, maintained for high clearance vehicles. This is consistent with the recommendations of the Española District Roads Analysis Process (RAP) for this area.

The operational effects of the Proposed Action on land use would be similar to those identified under the construction effects.

Direct and Indirect Effects of the Sediment Facility Alternatives

Construction Effects. Two sediment facility alternatives to the Proposed Action are considered. Each sediment facility alternative would have slightly different construction effects than the Proposed Action. For example, under Alternative SF1, the sediment separation facility would be located further from the diversion structure and thus there would need to be a longer pipeline, which means more land disturbed and additional power to the pumps to ensure that the water reaches the sediment facility. Under Alternative SF2, there would be no return pipeline back to the river, and trucks would need to haul the sediment offsite.

Operation Effects. Operation effects of Alternative SF1 would be similar to those identified for the Proposed Action. With no return line constructed under Alternative SF2, truck hauling of sand would be required resulting in increased truck traffic on Buckman Road.

Direct and Indirect Effects of the Pipeline Route Alternatives

Construction Effects. Alternative RWP1 would involve substituting a single pipeline for a double pipeline from Booster Station 1A to proposed Booster Station 2A. This would reduce disturbance of land along the Buckman Road corridor because only one trench would be dug instead of two. Consequently, effects on land use would be reduced from those identified for the Proposed Action. However, effects on existing infrastructure and utilities along the Buckman corridor would be the same as those identified for the Proposed Action.

The treated water pipeline under Alternative TWP1 would run 18,193 feet along the boundary between Las Campanas and BLM lands on Las Campanas property. Las Campanas has already planned for utility corridors on its property. Hence, effects on land use would be the same as those for the Proposed Action. Pipeline under Alternative TWP2 would run 21,528 feet on BLM lands in the existing Dead Dog Leg corridor except for a distance of about 1 mile. For this distance, BLM would have to establish a new pipeline corridor, resulting in a change in land use for this stretch. The pipeline route under Alternative TWP3 would run 30,337 feet along existing utility corridors and, thus, would result in the same effects on land use as the Proposed Action. Effects to existing utilities would depend on the timing of the implementation of Las Campanas' construction of their utility corridors and on other factors.

Operation Effects. Operation effects to land use, infrastructure, and utilities from all alternative pipeline routes would be similar to those identified for the Proposed Action.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. The effect on land tenure and use would be similar to the Proposed Action. AGP1a would result in approximately 1.8 additional acres (based on a 30-foot-wide corridor) of additional land disturbance for the power line connection between the existing power source and the MRC WTP; however, the power line would be located within an existing ROW and, therefore, would not change land tenure and use. Under AGP1a the new substation would be constructed along Caja del Rio Road instead of next to the MRC WTP; therefore, no effects to grazing would result from the construction and operation of the new substation.

Cumulative Effects

Most of the project facilities would be developed within the existing utility corridors. Therefore, no additive cumulative effects on land tenure and use, infrastructure, and utilities are expected from project implementation of the Proposed Action or alternatives to the Proposed Action.

Surface Water Resources

The Buckman Project area is located in an area of relative isolation in a region of diverse landforms and elevation. The surface water description and discussion provides a general overview of the surface water environment that is likely to be affected by the project, and also includes an evaluation of the environmental consequences to surface water that would be associated with the Buckman Project.

Affected Environment

The proposed diversion would be located on the Rio Grande about 15 miles northwest of the City of Santa Fe, and about 3 miles downstream of the Otowi Bridge stream gaging station. The hydrologic setting includes the following components:

- The Rio Chama watershed,
- The Rio Grande between the confluence with Rio Chama and Cochiti Reservoir, and
- Cochiti Dam and Reservoir.

Hydrologic Setting. There are four reservoirs within this study area that are relevant to the discussions that follow: Heron, El Vado, Abiquiu, and Cochiti. Table 9 provides a summary of information about each of these reservoirs.

Rio Chama Watershed. The Rio Chama originates in extreme southern Colorado and flows 115 miles south and east to its confluence with the Rio Grande. The Rio Chama is the largest tributary to the Rio Grande in New Mexico. Total river length in New Mexico below Heron Reservoir is approximately 60 miles, with a drainage area of 3,159 square miles, of which 2,146 square miles are above Abiquiu Dam. Elevations in the watershed range from about 12,000 feet above sea level in the San Juan Mountains to about 5,600 feet above sea level at the mouth of the Rio Chama (USACE 1995).

- **Heron Dam and Reservoir (Rio Chama)** — Heron Dam and Reservoir are located on Willow Creek, a tributary of the Rio Chama, just above the creek's confluence with the Rio Chama. The dam and reservoir provide a regulating and storage capability for San Juan River water, as authorized by the Colorado River Compact, for water diverted through the Continental Divide via the San Juan-Chama Project. Heron Dam is located about 80 miles northwest of Santa Fe.
- **El Vado Dam and Reservoir (Rio Chama)** — El Vado Dam, located on the Rio Chama about 5 miles downstream from Heron Reservoir, was built by the MRGCD in 1934-1935 and was rehabilitated by BOR in 1954-1955. It is currently operated by agreement with BOR. Native waters stored and released from El Vado are subject to restrictions of the Rio Grande Compact. Water imported into the Rio Grande via the San Juan-Chama Project and stored in El Vado Reservoir is not subject to restrictions under the Rio Grande Compact. Signed in 1938, the Rio Grande Compact was entered into by the states of

Colorado, New Mexico, and Texas, with consent of the United States Congress to apportion the waters of the Rio Grande Basin.

- **Rio Chama from El Vado Dam to Abiquiu Reservoir** — On November 7, 1988, Congress passed Public Law (PL) 100-633, which added two segments of the Rio Chama between El Vado and Abiquiu Reservoirs into the national Wild and Scenic River system. The two segments combined are approximately 25 miles in length.
- **Abiquiu Dam and Reservoir (Rio Chama)** — Abiquiu Dam is located 32 river miles upstream from the Rio Chama's confluence with the Rio Grande. Abiquiu Dam and Reservoir are operated primarily for flood and sediment control, as well as storage of San Juan-Chama water. The USACE Albuquerque District operates Abiquiu Dam under PL 97-140. The San Juan-Chama water storage pool has a water surface elevation of 6,220 feet above sea level, with a current storage capacity of 189,307 acre feet. The contract with USACE for the San Juan-Chama Project allows storage of up to 200,000 acre feet of water in Abiquiu Reservoir.
- **Rio Chama from Abiquiu Dam to Rio Grande Confluence** — Abiquiu Dam has regulated Rio Chama flows below the dam since 1963. The releases from the dam support the production of salmonids for several miles downstream (BOR/City of Albuquerque 2002). Since Abiquiu Dam was constructed, the average annual flow in the Rio Chama below the dam has been about 500 cfs. Seasonally, the average low flow month has been January, with an average flow of less than 200 cfs, and the average high flow month has been May, with an average flow of about 1,150 cfs.
- **Rio Chama Acequia (irrigation ditch)** — Currently it is estimated that there are 800 community acequia associations, mostly in the north central portions of New Mexico (USACE 1999). Seventeen acequias currently exist on the Rio Chama from Abiquiu to the Rio Grande confluence near Española. The reported rates of diversion for 15 of these acequias are up to 15 cfs (USACE 1999).

  The diversion structure for each acequia consists of either a diversion dam or heading structure. The distinction between a heading and diversion dam is that a heading does not span the entire channel, whereas a diversion dam does. These structures have varying construction techniques. Brush, timbers, and boulders comprise the bulk of the less permanent structures. Acequia diversion structures require frequent maintenance and modifications to keep operating after high flows and to enable diversions at low flows. The permanent structures are concrete or gabion dams with integrated sluiceways, control gates, and headgates.

Rio Grande from Confluence with Rio Chama to Cochiti Reservoir. The physical form of the Rio Grande changes below its confluence with the Rio Chama. The Rio Chama carries a much higher load of sand and fine sediment than does the Rio Grande above the confluence. This factor and the increase in flow combine to make the Rio Grande below the Rio Chama a wider, flatter, and sandier river.

The reach of the Rio Grande from its confluence with the Rio Chama to the upstream limit of the Cochiti Reservoir water surface pool is approximately 15 miles long. The average slope of the riverbed is about 6 feet per mile, and the channel width averages about 300 feet. Predominant bed materials are gravel and sand, and the riverbanks are largely sandy with some gravel. Major tributaries in the reach are the Rio Pojoaque and Santa Cruz Creek, both ephemeral streams,

Table 9. Summary of reservoir data.

Reservoir Purpose	Storage Capacity (ac-ft)	Crest Elevation (ft)	Max Dam Height (ft)	Max Surface Area (ac)	Drainage Area (sq mi)	Type	Location	Operator
Heron Storage and delivery of San Juan-Chama water	401,000	7,199	269	5,950	193	Earthfill with crest 1,220 feet long	Located on Willow Creek, a tributary of the Rio Chama, just above the creek's confluence with the Rio Chama, 80 miles northwest of Santa Fe	State of New Mexico developed Heron Lake State Park by agreement with BOR and is responsible for operation and maintenance
El Vado Water storage for irrigation, recreation, incidental flood control, and sediment control	209,330 with 180,000 available because of sediments	6,902	205	3,200	877	Earthfill	Located on the Rio Chama about 5 miles downstream from Heron Reservoir	Built by MRGCD in 1934-1935; rehabilitated by BOR in 1954-1955; operated by agreement with BOR
Abiquiu Flood and sediment control, and San Juan-Chama water storage	1,212,000 at spillway crest with about 183,000 ac-ft for San Juan-Chama water[1]	6,375 maximum pool elevation	341	15,536	2,146	Rolled-earth structure with 30-foot top width	On Rio Chama, 32 miles upstream of Rio Grande confluence, about 50 miles northwest of Santa Fe	USACE Albuquerque District
Cochiti Primary flood control for snowmelt runoff control on mainstem of the Rio Grande	596,400 not counting sediment reductions	Approx. 5,475	250	9,365	14,900	Rolled, earth-filled embank-ment with a 5-mile crest length	On Middle Rio Grande, upstream of Rio Grande/Jemez River confluence, about 25 miles west-southwest of Santa Fe and about 25 river miles downstream of the proposed Buckman diversion	USACE Albuquerque District

[1] Only San Juan-Chama water is stored in Abiquiu Reservoir, the remaining capacity is for flood control or sedimentation or is excess (Source: compiled from USACE, Bureau of Reclamation and USGS databases available on the Internet.)

meaning they may become dry during the summer (BOR/City of Albuquerque 2002). Much of this reach is canyon bound, and the remainder in open flood plain.

Much of the upper reach of this segment near Española was channelized in the 1950s. Below the Rio Chama, the channel bottom width increases to 70 feet to accommodate a flow design capacity of 7,850 cfs. Prior to the addition of riverbank protection, the river had shown a tendency to flow in a natural braided and meandering state.

Levees were built in the 1950s to protect the City of Española from flooding. Past gravel mining activities have adversely impacted the Española reach. In extracting sand and gravel products, miners have excavated the actual riverbed at various locations. This lowering of the riverbed has steepened the river slope and destabilized the channel for a considerable distance upstream. Typically, the river responded by upstream downcutting of the riverbed, causing the banks to become excessively high and steep. Caving and sloughing of unstable banks has caused widening of the river channel and increased braiding (BOR/City of Albuquerque 2002).

The U.S. Geological Survey (USGS) Otowi gage is located about 10 miles below the confluence of the Rio Chama with the Rio Grande at the Otowi Bridge near San Ildefonso, New Mexico. The gage is located about 3 miles upstream of the Buckman Project site. The period of record for this gage is from February 1895 to December 1905 and June 1909 to the present, making it one of the oldest streamflow records in the United States. Since 1963, after Abiquiu Dam was constructed, the average annual flow at the Otowi gage has been about 1,500 cfs. Seasonally, the average high flow month has been May, with an average flow of about 3,400 cfs, and average flows from August through February typically range from about 800 to 1,000 cfs.

Much of the reach from the Otowi Bridge, including the area near the proposed diversion site, is confined within a canyon until it discharges into the pool of Cochiti Reservoir. The bed material here is dominated by sand, cobble, and some boulders. According to USGS flow records, at Otowi Bridge the width of the river is about 120 feet and the flow velocity is typically on the order of 3 feet per second during average flow conditions on the order of 1,500 cfs.

The proposed location of the Buckman Project is about 3 miles downstream of the Otowi gage. The streambed at this location is typical of the reach overall in that it is composed of gravel, cobbles, and boulders, with some sand. The proposed diversion structure location is immediately upstream of an arroyo, Cañada Ancha, on the south bank that is dry most of the year, but discharges during storm events. Cañada Ancha passes through the Las Campanas community and drains a large portion of the Buckman area.

Cochiti Dam and Reservoir (Rio Grande). The Flood Control Act of 1960 authorized construction of the Cochiti Dam and Reservoir. Cochiti Dam is located on the Middle Rio Grande in Sandoval County in north-central New Mexico. It is located just downstream of White Rock Canyon near the confluence of the Santa Fe River and the Cañada de Cochiti. It is upstream of the confluence of the Rio Grande with the Jemez River. Cochiti Reservoir (lake) has a surface area at the top of the flood control pool that extends approximately 20 miles upstream into White Rock Canyon. Cochiti Dam serves as a diversion point for irrigation water for downstream users. Water is released to the Cochiti Eastside Main Canal on the left (east) bank and to the Sile Main Canal on the right (west) bank for irrigation of several thousand acres. Use of the river for irrigation in this area predates the construction of Cochiti Dam by many years.

Cochiti Reservoir is operated for flood control, sediment control, recreation, and the conservation and development of fish and wildlife resources. During normal, non-flood-control operation, irrigation and other requirements are met by regulating outflows to equal inflows to the extent possible.

Streamflow. A maximum flow in the Rio Chama below Abiquiu Dam of 2,990 cfs was recorded in July 1965, and there have been times when there was no flow in the channel since Abiquiu began operation in February 1963 (USACE 1995). Average monthly flows below Abiquiu Dam are illustrated in Figure 23. Evacuation of San Juan-Chama water stored in Abiquiu Reservoir may be required when the snowmelt forecast indicates a need for flood capacity exceeding 302,000 acre feet. The snowmelt runoff forecast point for the Rio Chama is the inflow to El Vado Reservoir. In the Rio Chama below Abiquiu Dam, summer and fall flows are higher than natural due to increased reservoir releases, including releases of imported San Juan-Chama water and storage from Abiquiu Reservoir. The average annual flow in the Rio Chama below Abiquiu Dam was about 500 cfs from 1962 to 2001. During this time period average annual flows have ranged from a low of 201 cfs in 1964 to a high value of 946 cfs in 1987.

The Otowi gage is located about 10 miles downstream from the confluence of the Rio Grande and Rio Chama and about 3 miles upstream from the proposed Buckman Project site. This location makes this gage useful for determining the effects of San Juan-Chama Project releases, which began in 1971, on Rio Grande flows. From 1971 to 1998, San Juan-Chama water increased flows at the Otowi gage by an average of 73 cfs, or about 5 percent of non-San Juan-Chama flow.

Because of its proximity to the Buckman site, the Otowi gage is useful for estimating the effects of the proposed diversion on flows in the Rio Grande. Figure 24 illustrates annual maximum daily flows in the Rio Grande at the Otowi gage from 1900 to 2000. Note that the period from 1963 to 2000 is shown separately from the earlier record because it is believed to be representative of current flow conditions, with Abiquiu Dam and flow regulations in place. The Otowi gage is the measuring point to determine New Mexico's obligation to Texas under the Rio Grande Compact. In accordance with the Colorado and upper Colorado River and Rio Grande Compacts, the inflows from the San Juan-Chama Project are specifically excluded from native flows at the Otowi gage and are accounted for separately.

Flows in the Rio Grande at Otowi vary with the seasons as shown in Figure 25 and 26. Figure 25 illustrates how average monthly flows have varied before and after the construction of Abiquiu Dam. Monthly average flows from August through February for the period 1963 to 2001 range from about 800 cfs to 1,000 cfs, whereas the average monthly flow for May for the same period is about 3,400 cfs. Figure 25 also demonstrates the effects of Abiquiu Dam on Rio Grande flows, evidenced by generally lower peak flows after the dam was constructed. Flow data gathered by the USGS and shown in these and subsequent figures can be found at *http://waterdata.usgs.gov/nm/*.

Figure 26 illustrates how minimum, average, median, and maximum seasonal and annual flows have varied from 1963 through 2001. In Figure 26, the seasons have been defined by month as follows: winter = January-March, spring = April-June, summer = July-September, and fall = October-December. From 1963 through September 2001, the average annual flow in the Rio Grande at this site ranged from 542 cfs (1964) to 2,751 cfs (1985). The average annual flow for the period from January 1963 through September 2001 was 1,461 cfs.

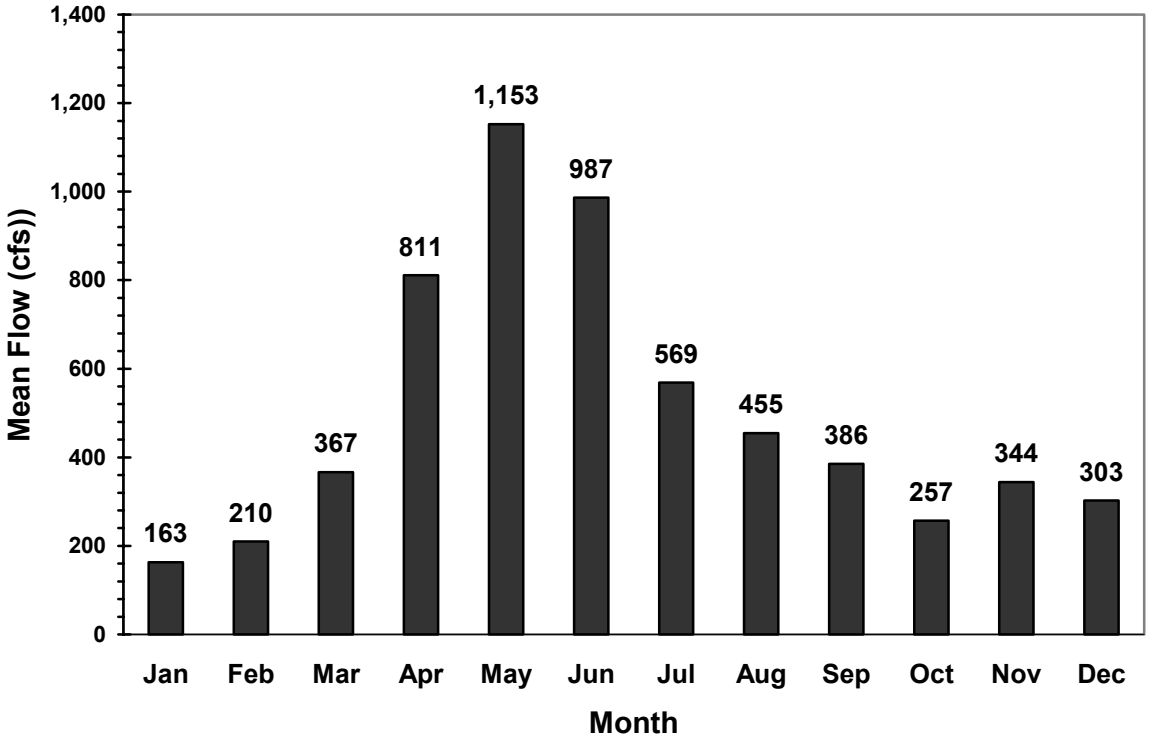

Figure 23. Monthly average streamflows in the Rio Chama below Abiquiu Dam. (Source: *http://waterdata.usgs.gov/nwis*)

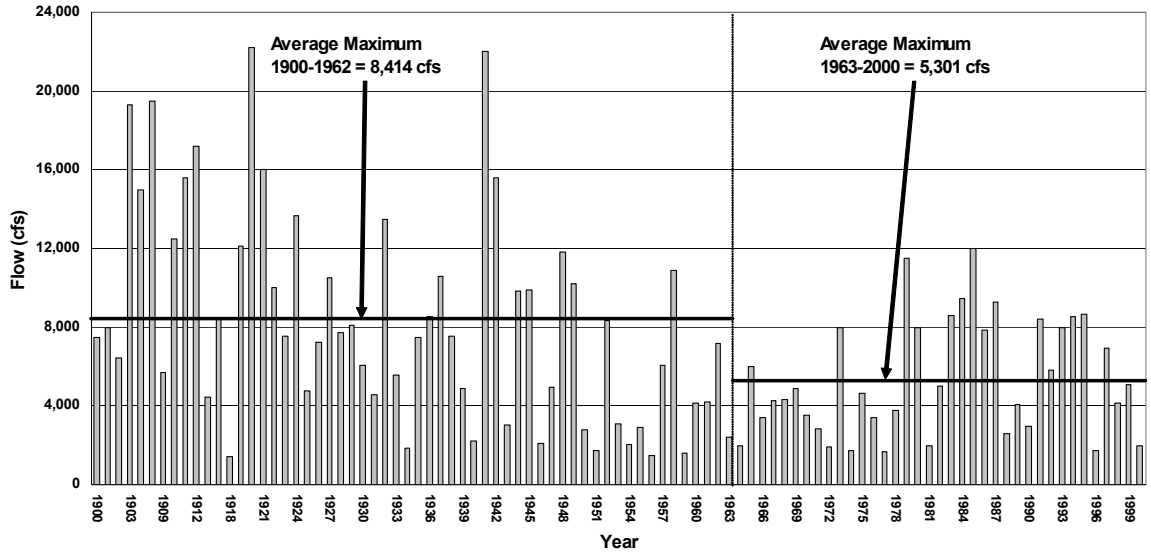

Figure 24. Maximum daily flows on the Rio Grande at the Otowi Gage, 1900-2000. (Source: *http://waterdata.usgs.gov/nwis*)

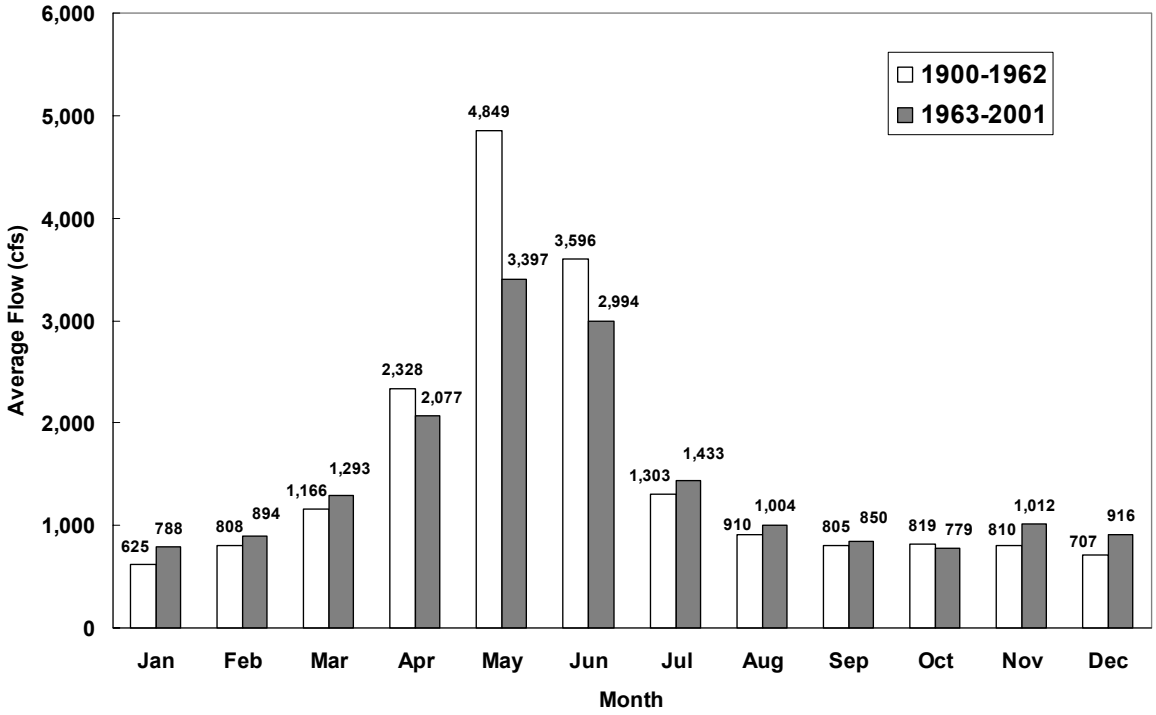

Figure 25. Average monthly streamflow (cfs) at Otowi Bridge 1900 – 1962 and 1963 – Sep 2001. (Source: *http://waterdata.usgs.gov/nwis*)

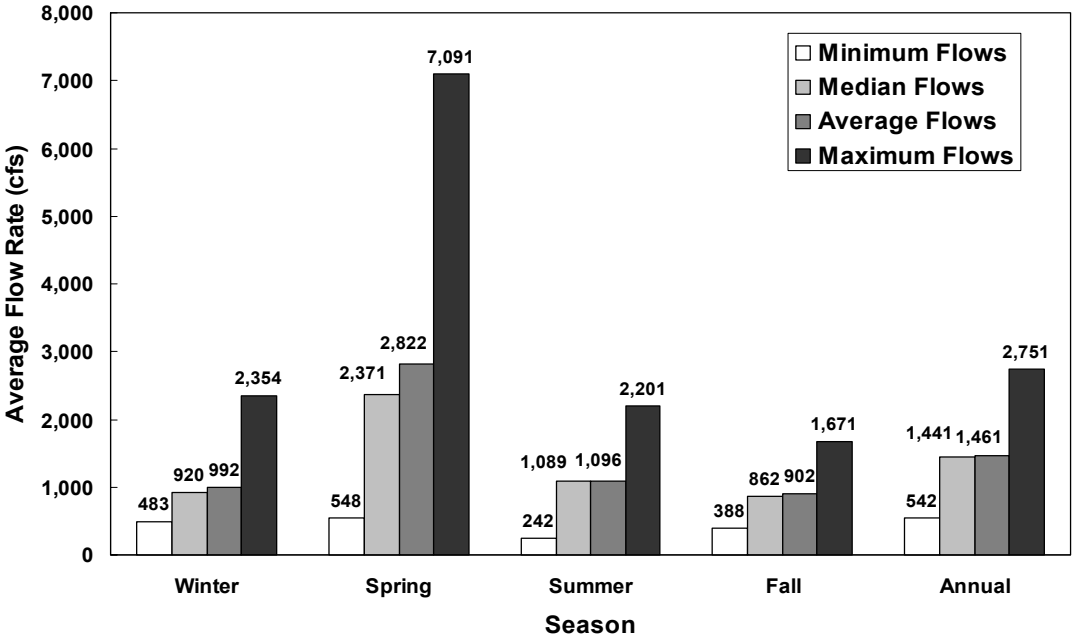

Figure 26. Average seasonal streamflow (cfs) at Otowi Bridge, Jan 1963 – Sep 2001. (Source: http://waterdata.usgs.gov/nwis)

Downstream from the Buckman site, the Rio Grande has been modified into a highly regulated and confined river system. Within a 116-mile stretch, there are four substantive irrigation diversion points: Cochiti, Angostura, Isleta, and San Acacia. These structures divert water from the river to the Middle Rio Grande Project system of canals and laterals for irrigation of 50,000 to 64,000 acres of cropland, including up to 8,300 acres of Pueblo cropland. Riverside drains and waterways collect surface water and shallow ground water, and convey it back to the river at numerous locations.

Surface Water Quality. Water quality in any reach of a river can be influenced by upstream flows. There are historical sources of contamination from mining and heavy metals in northern New Mexico's Red River drainage that enter the Rio Grande. There are discharges of wastewater effluent from the communities upstream of the Rio Grande/Rio Chama confluence. Some tributary streams that enter this reach can introduce high sediment loads during storm events. In addition, the water quality within the reach may also be influenced by other contaminants that enter the river from dispersed sources such as from the air or direct runoff.

Examination of the information sources used to characterize inorganic water chemistry indicates that the general quality of surface waters in the Jemez y Sangre planning region (an area encompassing three northern New Mexico counties: Los Alamos, Rio Arriba, and Santa Fe) is generally good with respect to the water quality standards (Jemez y Sangre 2001). Total dissolved solids (TDS) levels in surface waters typically fall below a value of 250 milligrams per liter (mg/L); such TDS concentrations are substantially below the regulatory standard of 500 mg/L for this reach, and well below the 1,000 to 3,000 mg/L range that the Interstate Stream Commission (ISC) uses to classify "slightly saline" waters (Jemez y Sangre 2001). In addition to meeting TDS standards, surface waters in the study region typically comply with the other water quality standards and guidelines.

The most abundant cation in regional surface waters is calcium, with sodium, magnesium, and iron occurring in lesser quantities. The predominant anions are bicarbonate and sulfate. Over most of the study region, the surface water is characterized as a calcium-bicarbonate type, although calcium-magnesium-bicarbonate and sodium bicarbonate types are occasionally observed (Jemez y Sangre 2001). Most surface waters in the study region are classified as moderately hard to hard because of the concentrations of calcium and magnesium in them.

Nutrients (typically compounds with nitrogen or phosphorous) dissolved in surface waters of the region can occur from agricultural land uses, urbanization, and wastewater discharges. Contributions to dissolved nutrients on the main stem Rio Grande are made by agricultural sources from as far north as San Luis Valley in southern Colorado and the Rio Chama above El Vado Reservoir. Noticeable nutrient sources in and from tributaries include irrigated areas near Española, one of the more urbanized locales in the study region, and along the lower Santa Fe River downstream of the City of Santa Fe. Surface water in the Pojoaque Valley also occasionally contains elevated levels of nutrients.

A National Water Quality Assessment (NAWQA) study of the Rio Grande Valley (Jemez y Sangre 2001) was conducted by the USGS from 1993 to 1995. At most of the sites included in the study, monthly samples were gathered between April 1993 and September 1995, although the actual sampling schedule varied somewhat. The water chemistry variables that were examined included dissolved solids, major inorganic constituents, and nutrients. During the 1993 to 1995 sampling period, the median pH at Otowi Bridge was 8.1 and the median dissolved oxygen (DO)

percent of saturation was 95. The average and maximum observed TDS levels were 186 and 221 mg/L, respectively. Hardness ranged from 95 to 140 mg/L as calcium carbonate, indicating moderately hard to hard water.

Levels of nutrients (compounds of nitrogen and phosphorous that tend to reduce oxygen levels in water) tend to be slightly higher at the Otowi site than in the Rio Chama, but are still quite low. This is partially due to the tendency of both flows and nutrient concentrations to be somewhat higher on the main channel of the Rio Grande above Española than they are on the Rio Chama (Jemez y Sangre 2001). During the NAWQA study, the Otowi median concentration of nitrite plus nitrate as nitrogen was 0.06 mg/L. This can be compared to the EPA Maximum Contaminant Level standard for drinking water of 10 mg/L.

Turbidity, a reduction in the clarity of water in natural rivers, is often strongly influenced by the presence of suspended sediment particles, particularly fine silts and clays. Suspended organic matter and, to a lesser extent, dissolved constituents may also influence turbidity. Suspended sediments are present in virtually all natural river systems. Silts and clays are derived from the areas that are drained by a river and the amount of fine material that reaches a river can be affected by practices in the watershed such as agriculture or urbanization. Because of the turbulence in a river such as the Rio Grande, silts and clays do not normally settle out until the water reaches a quiet body of water such as a reservoir or natural lake.

Between January 1990 and September 2001, the USGS recorded 98 turbidity samples (Figure 27) and 126 suspended sediment samples (Figure 28) at Otowi. The samples were collected at a wide range of instantaneous discharges, from less than 500 cfs to over 8,000 cfs. About 15 percent of the turbidity samples were above the current State standard. The State has proposed removal of the site-specific 50 Nephelometric Turbidity Unit (NTU) turbidity standard as part of its 2003 Triennial Review Process. The State has also proposed changes to its general surface water quality criteria that would not limit increases to no more than 10 NTU over background turbidity when background turbidity is 50 NTU or less, or 20 percent when the background turbidity is more than 50 NTU.

Water Use and Water Rights. Water use and water rights issues include surface water and ground water consideration, both of which are discussed here. Water use and water rights for the City, County, and Las Campanas are discussed in that order. Additional considerations related strictly to ground water are discussed in the “Ground Water” section.

For the 10-year period from 1990 through 1999, average annual water usage for the City, including water supplied to the County and Las Campanas, has been supplied from the following sources (see Figure 29):

- Santa Fe River (from water stored in Nichols and McClure Reservoirs): 4,637 ac-ft/yr
- St. Michael’s Well: 215 ac-ft/yr
- City Wells: 2,051 ac-ft/yr
- Buckman Wells: 4,911 ac-ft/yr
- Total annual withdrawals: 11,814 ac-ft/yr

The City holds water rights applicable to each of its sources of supply. For the Buckman Project, relevant City water rights and agreements include a contractual agreement with the BOR for a joint 5,605 ac-ft/yr City and County San Juan-Chama Project contract allocation (for analysis

purposes, it has been assumed that the City would use 5,230 ac-ft/yr and the County would use 375 ac-ft/yr), and about 131 ac-ft/yr of native Rio Grande rights. The City has a permit with the New Mexico Office of the State Engineer (OSE) to pump up to 10,000 ac-ft/yr from the Buckman Well Field. This permit requires the City to offset stream depletions caused by pumping, which is administered by OSE using ground water modeling. Historically, the City has used a portion of its San Juan-Chama contract allocation to offset depletions to the Rio Grande, and water rights holdings on the Rio Pojoaque and Tesuque Creek to offset depletions to those tributaries to the Rio Grande.

The City is considering the lease of 3,000 ac-ft/yr of San Juan-Chama Project water from the Jicarilla Apache Nation. Upon execution by the parties and approval by BOR, this lease would supplement the City's surface water supplies through 2057. The City could use the leased water within the City's Water Utility Service System and/or for meeting regulatory requirements associated with the City's Water Utility Service System. To the extent that this water may be diverted through the Buckman Project, the total facility diversion would not exceed 8,730 ac-ft/yr or 32 cfs.

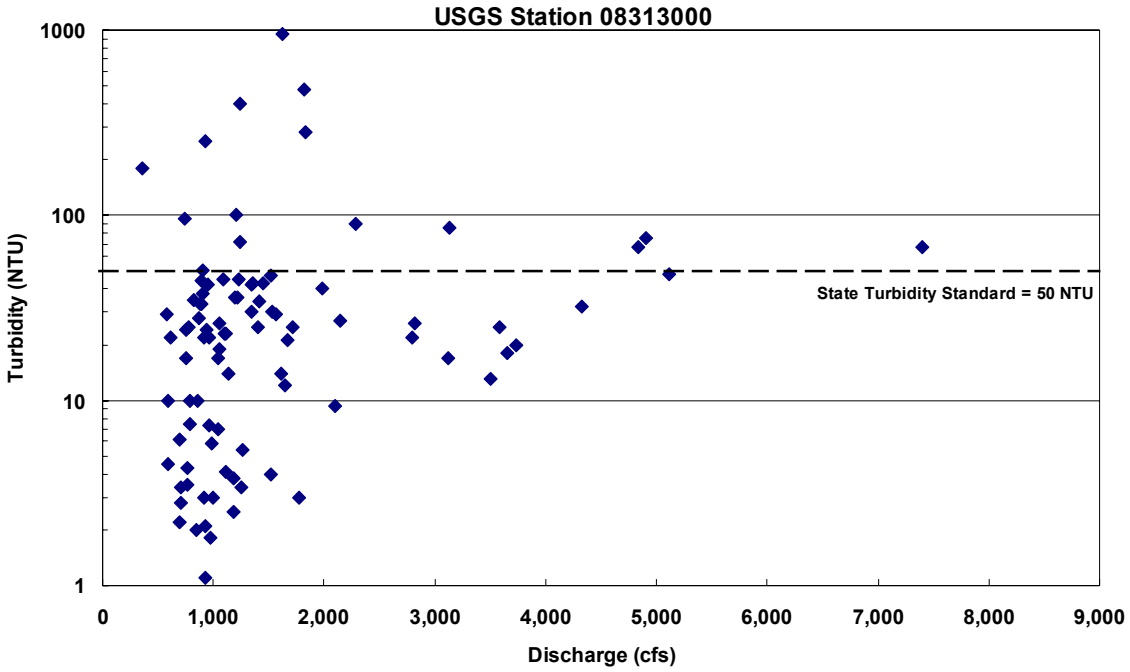

Figure 27. Turbidity data recorded at Otowi Bridge (January 1990 – September 2001). (Source: *http://waterdata.usgs.gov/nwis*)

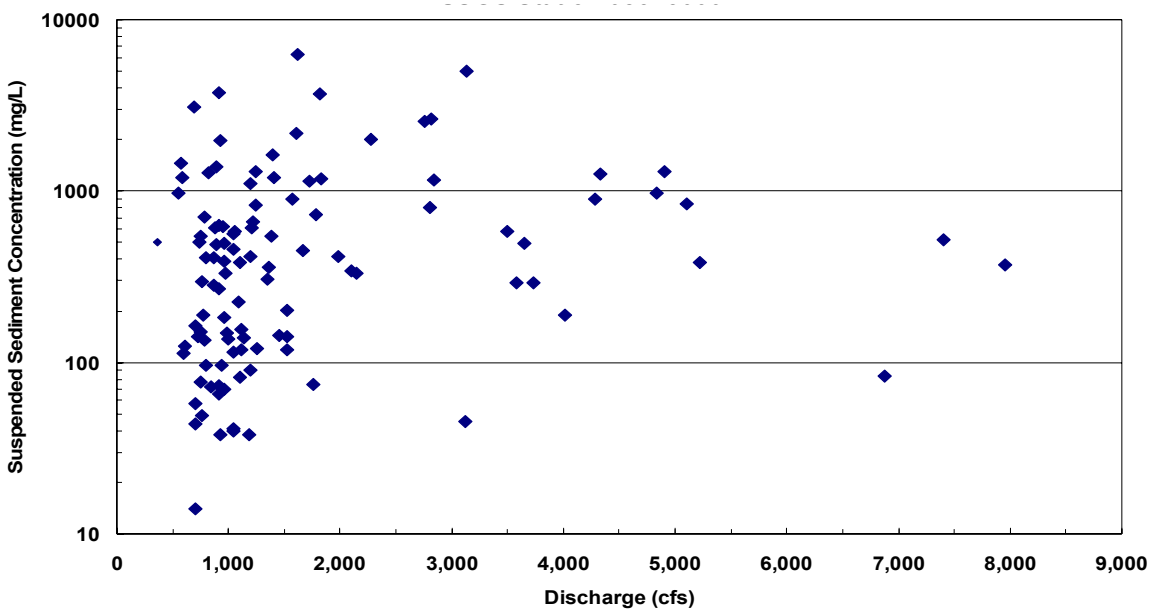

Figure 28. Suspended sediment data recorded at Otowi Bridge (Jan 1990 – Sep 2001). (Source: *http://waterdata.usgs.gov/nwis)*

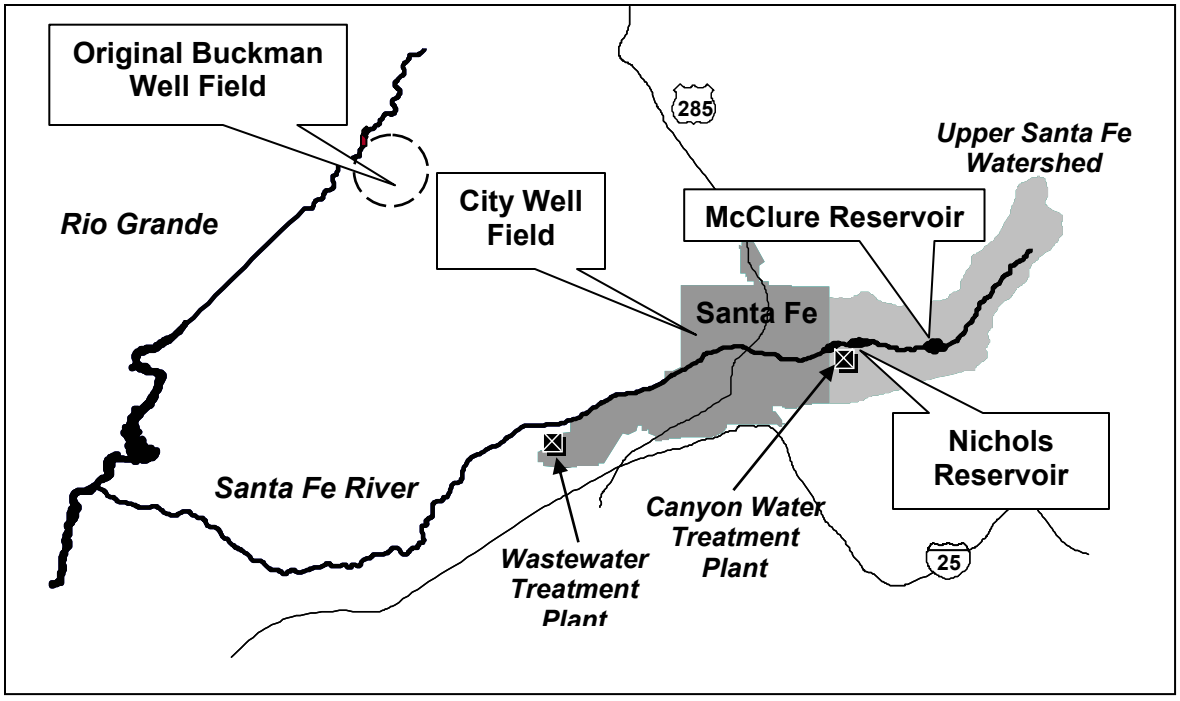

Figure 29. City of Santa Fe existing water supply system.

The primary goal of the Buckman Project is to quickly provide an increased level of drought protection and lower the stress on the existing Buckman Well Field. To meet longer term needs associated with increases in demand over time, the City and County would be evaluating additional supply sources in the coming years. The longer term planning would include continued use of the Buckman Project as one component of supply for meeting the City and County's long-term needs. However, in the interim—before the long-term alternative components can be implemented—it is expected that some growth in demand would occur. Thus, the Buckman Project was sized to meet the City and County needs now and through approximately 2010, and Las Campanas needs at full build-out which is anticipated to occur between approximately 2010 and 2015.

Current demands on the City's water system (including County usage, but excluding Las Campanas usage) in normal precipitation years have been estimated to be approximately 12,000 ac-ft/yr for the year 2001. (Note: In 2000, water use restrictions related to drought conditions reduced this demand to 11,282 ac-ft/yr, including approximately 117 ac-ft/yr provided to the County.) The City's demand in 2010 is estimated to be between 13,310 ac-ft/yr (drought conditions) and 14,760 ac-ft/yr (non-drought conditions) exclusive of any water supplied to the County or Las Campanas (CDM 2001a). The City proposes to divert up to 5,230 ac-ft/yr through the Buckman Project. This amount is equivalent to the City's San Juan-Chama water contract allocation, which would allow it to meet its expected demand in 2010 while reducing pumping from the Buckman Well Field.

The City has an agreement to provide up to 500 ac-ft/yr of water through the City's system to the County. The County has indicated that it expects its 2010 annual demands to be 1,700 ac-ft/yr. Currently the County holds 375 ac-ft/yr of San Juan-Chama contract allocation. According to the County's 40-Year Water Plan, the County has acquired 71.2 ac-ft/yr of additional consumptive water rights in Socorro. The evaluation of near-term San Juan-Chama alternatives was based on an assumption that the County would secure all additional water rights needed to meet its 2010 projected need of 1,700 ac-ft/yr. It is also assumed that the agreement would be extended indefinitely and expanded to accommodate the 1,700 ac-ft/yr of County demands.

The current water demand at Las Campanas is about 1,000 ac-ft/yr. The total annual water demand (for irrigation and potable treatment and use) for Las Campanas at build-out would be 1,800 ac-ft/yr. Build-out is anticipated in 10 to 15 years. Las Campanas representatives have stated that they have secured water rights needed through purchase and lease arrangements to meet the 2010 projected need of 1,800 ac-ft/yr.

Current and projected water demands are illustrated in Figure 30, using the City's upper demand projection.

Flood Plains. Federal Emergency Management Agency (FEMA) maps are available that show the inundation area that would occur with a 100-year flood (a flood event with a 1 percent chance of occurrence each year) along the Rio Grande (FEMA 1988). These maps, which are quite large, range in scale from 1:6,000 in urban areas to 1:24,000 in rural settings, are included here by reference. Flood zone maps can be obtained from the FEMA at *http://web1.msc.fema.gov/webapp/commerce/command/ExecMacro/MSC/macros/welcome.d2w/report*. A portion of the flood zone map in the vicinity of the proposed diversion site is shown in Figure 31.

Flood events in the Buckman area of the Rio Grande have been reduced by the flood control reservoirs upstream. However, heavy rainfall events occasionally occur along this reach, resulting in higher than average discharge through White Rock Canyon. Over time, high flow events have caused the river to reclaim an old meander channel near the terminus of Buckman Road. Subsequent flood events have removed the cobble bar and sand bars that are between the abandoned meander channel and the active channel. This suggests that high rates of sediment transport occur that move boulders, cobbles, sand, silt, and clay down the Rio Grande through White Rock Canyon.

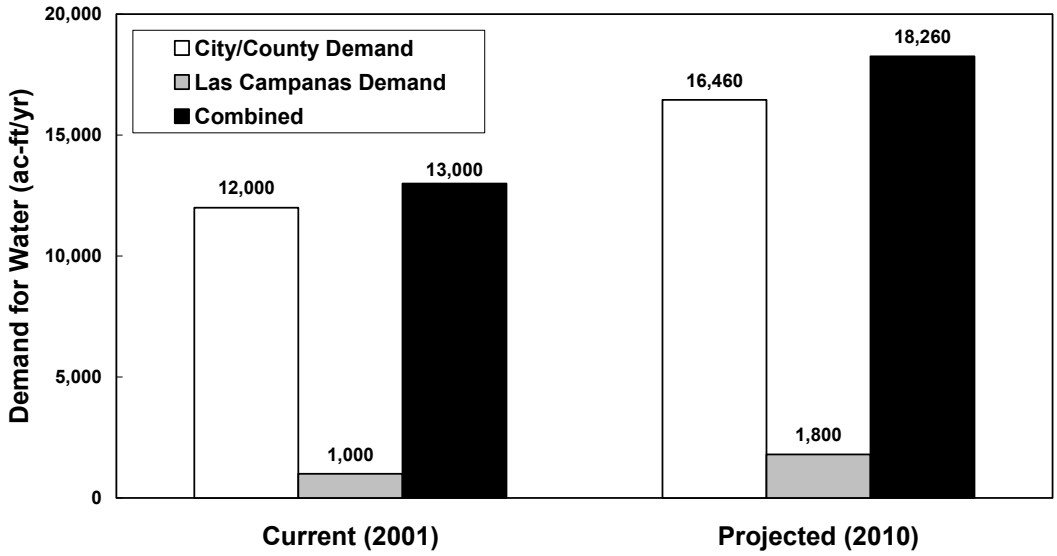

Figure 30. Water demand for current and projected future conditions (showing City's upper demand estimate for 2010).

The Cañada Ancha Arroyo is the principal drainage corridor for lands surrounding the Buckman Road and Dead Dog Leg corridors. During flood events, everything from boulders to suspended load sediments are carried down the arroyo. Sediment that is transported through the arroyo, along with material eroded along the banks of the arroyo, is discharged into the Rio Grande. The Rio Grande then carries away the sediments, or the sediment stabilizes the channel from further incision at the confluence. The proposed diversion facility has been located at a point along the Rio Grande immediately upstream of the confluence with Cañada Ancha. Comparisons of aerial photographs have shown that this location of the channel bank has been shown to be stable over a period of nearly 60 years.

Environmental Consequences

Neither the Proposed Action nor its alternatives are expected to have noticeable effects on surface water resources, either during construction or once it is operational. Generally, with the project in place, the effect on average flows in the Rio Grande would be less than 1 percent. Of that 1 percent effect, about two-thirds would be associated with diversion of water imported to the Rio Grande from the inter-basin San Juan-Chama Project. In addition, the project would have little measurable effect on water quality and essentially no effect on flooding or flood potential. There

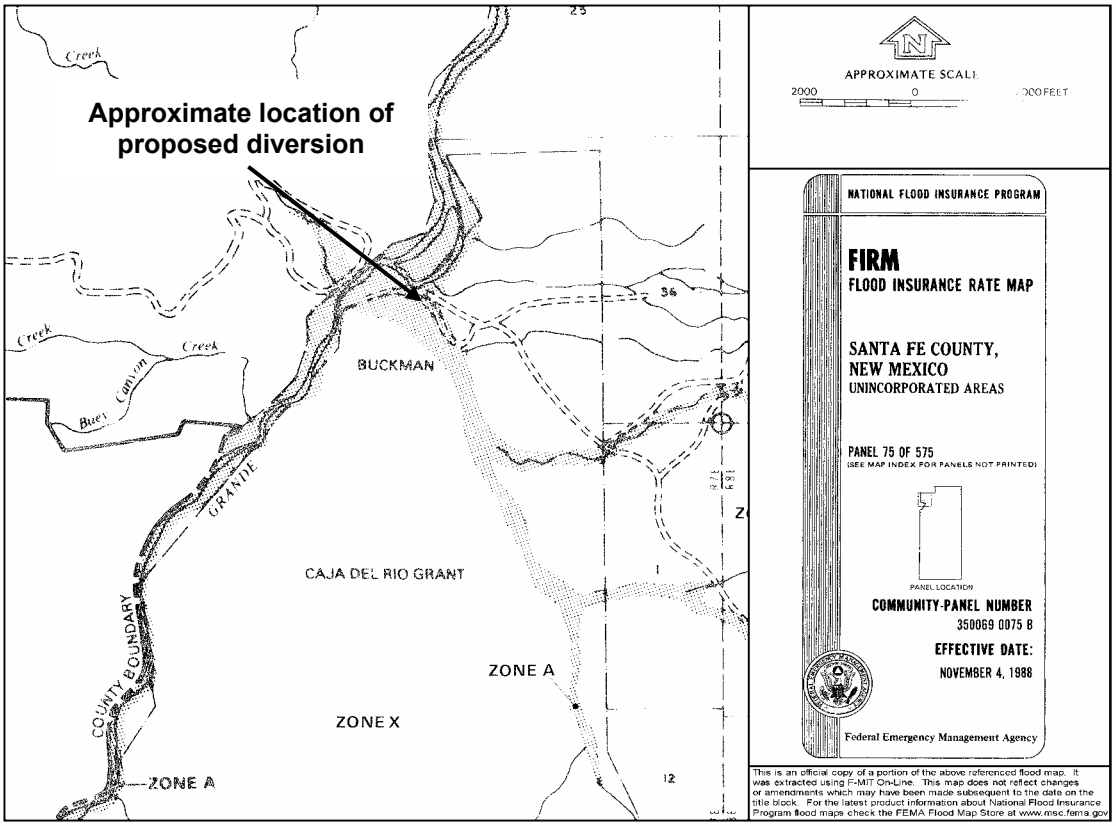

Figure 31. Flood zone designation in the vicinity of the proposed Buckman Diversion, where Zone A indicates the 100-year flood zone boundary. (Source: FEMA Web site, see text.)

would be a beneficial effect on water use in the region. Some indirect effects on water rights would occur as the applicants make certain that water rights are in place in order to fully utilize the diversion.

Annual, monthly, and seasonal effects on streamflow are discussed in this section. Although some natural variations in flow occur throughout each month, monthly flow was judged to be the smallest reasonable unit of time to evaluate the effects of the project. Flow in rivers and streams is normally expressed in cfs, whereas water usage is expressed in ac-ft/yr. A flow of 1.34 cfs for an entire year would be equivalent to 1,000 ac-ft/yr. This section addresses changes to flow; however, effects of flow changes on biota, including the silvery minnow, are discussed in the section, “Rio Grande Silvery Minnow” later in this chapter.

No Action Alternative

The No Action Alternative is defined as no new direct diversion at the Buckman site. The applicants would continue to seek other methods to meet their near-term water supply needs. The Buckman area has served as a source of water for the Santa Fe area since 1972. The Buckman Well Field currently consists of 13 wells and a transmission pipeline that supplies approximately 40 percent of the water supply for the Santa Fe area in a normal precipitation year. In recent

years, production from the Buckman Well Field has averaged about 5,200 ac-ft/yr. Surface water from the Santa Fe watershed supplies approximately 40 percent of the water supply in an average year of precipitation and the City Well Field provides the remaining 20 percent. These figures include the community of Las Campanas, which currently receives its water supply from the City. The County has an agreement with the City for up to 500 ac-ft/yr of water, but has used less than 200 ac-ft/yr under this agreement in recent years. The County also operates six wells that collectively produce about 77 ac-ft/yr.

Under the No Action Alternative, the Buckman Well Field would continue to provide about 40 percent of the City's water supply. The No Action Alternative would result in continued depletions of the aquifer in the Buckman area and the flows of the Rio Grande and its tributaries, which would continue to be offset by releases of San Juan-Chama water or purchased water rights. The delayed effects of pumping ground water at Buckman since 1972 would continue to be observed in the tributaries and the Rio Grande. The effects are delayed because of the distance between the streams and the well field. The effects on the Rio Grande are much more direct because of its close proximity to the well field. However, there are also residual depletion effects due to historic and ongoing pumping.

According to the permit from the New Mexico OSE, the City is required to offset any depletion of flows in the Rio Grande and its tributaries as a result of pumping from the Buckman Well Field. This has been accomplished with releases of San Juan-Chama water into the Rio Grande and by retiring native water rights owned by the City in the two tributaries and the Rio Grande. The two main Rio Grande tributaries in the region are the Rio Pojoaque and its tributary, Tesuque Creek, which are part of the Nambe, Tesuque, Pojoaque drainage system. The method used by the OSE to estimate stream depletions was used in the current analysis to determine the effects of the Buckman Well Field on the volumes of water flowing in these two streams. The results show that the cone of depression for the Buckman Well Field causes a small reduction in the volumes of ground water flowing into these tributaries and, thus, affects their overall flow. Both the City and Las Campanas have purchased and transferred or retired water rights in these tributaries to compensate for the depletions calculated by OSE. Approximately 63 ac-ft/yr in the Rio Pojoaque and approximately 43.3 ac-ft/yr (including accounting for Northwest Well requirements) in Tesuque Creek have been retired and dedicated to offsets required by Buckman pumping. These dedicated rights may only be used as offsets.

The Rio Pojoaque and Tesuque Creek experience reductions in flow because a portion of the water they convey comes from the discharge of ground water, in addition to surface runoff from snowmelt and rainfall. For 2001, a reduction of approximately 52 acre feet in the volume of water flowing in the Rio Pojoaque and a reduction of approximately 32 acre feet from the volume of water flowing in Tesuque Creek was estimated as a result of pumping at Buckman based on calculations using the OSE's numerical model. Historical data from a USGS gaging station indicate an average flow of 2,317 ac-ft/yr in Tesuque Creek (gaging station 8308025 near Tesuque). The data for Tesuque Creek are for the period between June 1998 and September 1999; this limited period of record may not fully characterize current conditions.

The center of the Buckman Well Field cone of depression lies close to the Rio Grande. This closeness results in a greater depletion of the Rio Grande flow than occurs in the Rio Pojoaque and Tesuque Creek. Computer modeling is also used by OSE to estimate the amount of flow reduction in the Rio Grande each year as a result of pumping the Buckman Well Field. Computer modeling using the OSE's numerical model estimated a depletion of approximately 2,569 acre

feet for 2001 in the volume of water flowing in the Rio Grande as a result of current and historical well field pumping at Buckman. The average depletion of the Rio Grande for the 5-year period from 1997 to 2001 was 2,487 ac-ft/yr. All Buckman well depletions on the Rio Grande are offset with San Juan-Chama water and a small amount of retired native Rio Grande rights.

In addition to the recently installed Well No. 9, an environmental assessment was recently prepared for four additional wells (Tetra Tech 2003) that have since been installed. With the addition of these four supplemental wells, by the end of 2006 the Rio Grande is expected to experience a reduction in flow of approximately 2,949 ac-ft/yr. By the end of 2060, the Rio Grande would experience a reduction in flow of approximately 4,507 ac-ft/yr. Buckman well depletions on the Rio Grande would continue to be offset with San Juan-Chama water and a small amount of retired native Rio Grande rights. Because of this, there would be no net depletion of water in the Rio Grande.

By the end of 2060, the anticipated effect on the Rio Pojoaque of operating all 13 wells at Buckman is projected to be a reduction in flow of approximately 327 ac-ft/yr. By the end of 2060, the anticipated effect on Tesuque Creek of operating all 13 wells at Buckman is projected to be a reduction in flow of approximately 167 ac-ft/yr. These numbers do not take into account OSE's permit requirements for the Buckman Well Field, which would prevent pumping at Buckman from resulting in depletions of these tributaries in amounts greater than the amount of water the City owns rights to in them. The actual rates the City would be allowed to pump through 2060 are impossible to predict because they depend upon future demands, the availability of other supplies, weather patterns, actual rates of pumping at Buckman during the most recent year, and other variables. The net result of OSE's Buckman Well Field permit requirements is that there can be no depletions to streamflows from pumping of the Buckman wells that are not fully offset. Depletions in streamflow are illustrated in Figure 32.

The No Action Alternative would not affect water quality or sediment transport in the river. Likewise, neither the flood plains nor the flood potential would be affected. However, the near-term demand for water in the region would not be satisfied by the current supply system. The applicants would seek other water rights and other methods for meeting the projected demand. Other than the alternatives addressed in this document, no other options are available to evaluate.

Direct and Indirect Effects of the Proposed Action

Minor flow reductions would occur downstream of the diversion. Under most flow conditions, reductions in native Rio Grande flows would be on the order of 1 percent. Upstream of the diversion, Rio Grande flows would be enhanced by about 4.2 cfs on average by additional releases of San Juan-Chama water. Effects on water quality, sediment transport, and flood plains and flooding would be essentially immeasurable. The effect on water use would be beneficial. The Proposed Action would allow the City to meet its water use needs to the year 2010, the County to meet its needs for a longer period, and Las Campanas to meet its needs through full build-out. The Proposed Action would not directly affect water rights, but would have some indirect effects. The City and County would exercise their full San Juan-Chama allocation. The County would need to secure additional rights to fully utilize its share of the capacity of the diversion and Las Campanas would need to maintain its existing leased rights.

Construction Effects. Localized disturbance of streamflow currents would occur during and after construction of the temporary cofferdam and upon removal of the cofferdam. This temporary disturbance would include some redirection of flows near the cofferdam structure. The cofferdam would be placed within a period of about 1 to 2 weeks, and a similar amount of time would be required for removal. The cofferdam is projected to be in place for approximately 5 months.

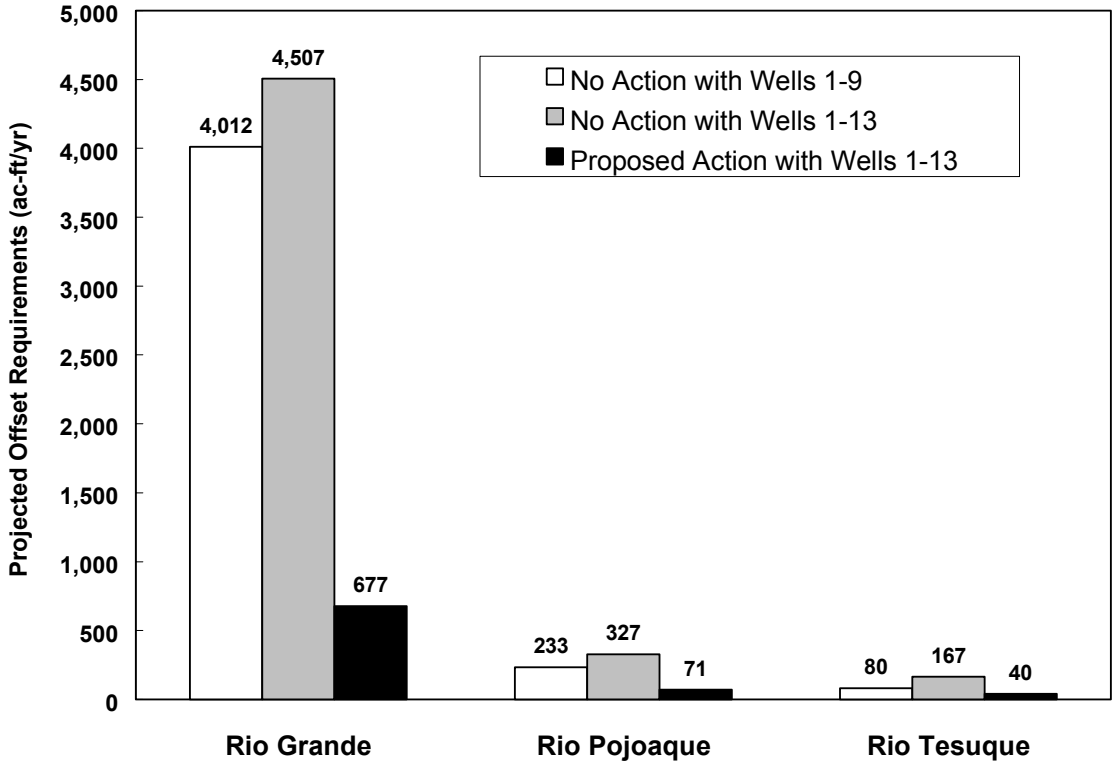

Figure 32. Projected offsetting requirements in 2060 in the Rio Grande and tributary flows. (Source: Modeling data provided by CDM—Permit Applicants' Contractor)

Since there would be no discharges to the flow or added contaminants, no serious short-term or long-term construction effects to water quality have been identified. Some temporary increases to turbidity would be expected during construction activities, primarily during placement and removal of the cofferdam. After completion of construction, turbidity would return to pre-construction levels. During construction of the diversion, effects on other water quality parameters would be minimal, including effects on the presence of dissolved solids, trace metals, or organic materials. The cofferdam would isolate flows from construction activities. As a condition of the construction permits, any spills of petroleum products or other materials would be cleaned up prior to removal of the cofferdam.

Operation Effects. The direct and indirect effects on surface water associated with operation of the Buckman Project are discussed in the following paragraphs.

Effects on Streamflow — Some localized changes in streamflow currents would occur near the diversion structure. The changes are not expected to affect the flow regime in the river. Generally, with the project in place, the effect on average flows in the Rio Grande would be less than 1 percent. Of that 1 percent effect, about two-thirds would be associated with diversion of water imported to the Rio Grande from the inter-basin San Juan-Chama Project. Streamflows upstream of the diversion would be enhanced by about 4.2 cfs on average through releases of San Juan-Chama Project water.

The volume of water diverted at Buckman would fluctuate through the year based upon water demands, availability of other sources, and operational protocol. Using historical water usage patterns and by developing estimates on water demands in 2010, an estimate of the maximum diversion by month in 2010 was made. This maximum monthly average flow was calculated based upon the total combined City, County, and Las Campanas demand minus availability of the other sources of water including the Santa Fe River, City Well Field, and Buckman Well Field. Under some conditions, the other sources may be limited or unavailable, such as during drought conditions or failure of the existing Buckman pipeline. The excess demand would be supplied by the diversion. The Las Campanas demand was then added to the City and County demand.

Table 3 in Chapter 2 shows the maximum monthly average diversion projections for all proponents for each month under 2010 drought conditions. The maximum monthly average diversion would not occur in every month, nor is it likely to occur in consecutive months. Peak flow through the diversion would occur during the summer months when water demand is the highest. During 7 months, the maximum monthly average flow would be less than 70 percent of the peak day diversion of 28.2 cfs. The daily diversion volume during any given month would vary from a net flow of zero to 28.2 cfs, averaging up to 12 cfs over the course of a year. For purposes of analysis, estimated average monthly diversions are estimated in Table 10. The diversion values shown in Table 3 and Table 10 do not include the “carriage” water. Up to an additional 4 cfs would be diverted and returned to the river with diverted sand near the point of diversion.

Table 10. Estimated average monthly diversions.

Month	cfs
January	6.8
February	7.7
March	8.5
April	11.0
May	14.4
June	15.8
July	15.8
August	14.4
September	13.7
October	11.9
November	6.8
December	7.7
Annual Average	12.0

As discussed in Chapter 2, the system may not operate under several conditions. The minimum design capacity would mitigate possible effects on the lowest flows in the river. The system would not be able to operate at full capacity when river flows are below about 200 cfs, and may be inoperable when river flows are below about 150 cfs.

During operation, maximum diversions from the river would be about 32 cfs, with about 4 cfs returned with the sand fraction of the sediment load, for a net maximum withdrawal of 28.2 cfs. The average annual diversion would be less than half this amount, up to about 12 cfs (8,730 ac-ft/yr), and would depend on demands and other factors. About 64 percent of the water withdrawn would be of releases from the San Juan-Chama Project. The average annual flow rate in the Rio Grande at the point of diversion, since the construction of Abiquiu Reservoir, has been 1,461 cfs.

The expected monthly maximum average diversions were scaled to estimate average monthly and seasonal diversions. A scaling factor was used so that the average of the monthly diversion would be equal to the annual average diversion of 12 cfs. The estimated average monthly diversions are shown in Table 10. Figure 33 shows the maximum average monthly diversion and the estimated average monthly diversion as a percent of the average monthly flows for the period January 1963 through September 2001 (see Figure 25 for monthly river flow data). Figure 34 shows similar data by season and annually (see Figure 26 for seasonal and annual river flow data). Note that seasons are defined the same as for Figure 26 (winter = January-March, spring = April-June, summer = July-September, and fall = October-December). The average diversion would be less than 1 percent of the total flow in the river (1963-2001), and the average diversion of native Rio Grande water would be less than a third of a percent of the total flow in the river.

For the period of January 1963 through September 2001, the lowest average monthly flow of record was 212 cfs for the month of July 1963. These low flows were probably partially caused by reservoir startup operations at Abiquiu. The projected average diversion for the Buckman Project would be up to 12 cfs. Had this diversion occurred in July 1963, it would have represented less than 6 percent of the lowest monthly flow of record. Of that total diversion, about 2 percent would have been native Rio Grande water and the remainder (4 percent) would be San Juan-Chama water.

Currently the City is required to offset about 2,600 ac-ft/yr of depletions in Rio Grande flows as a result of pumping from the Buckman Well Field. The City has historically used its approximately 131 ac-ft/yr of native Rio Grande rights to partially meet these offset requirements. With the diversion in place, the City and County could directly divert their full allocation of San Juan-Chama water, 5,605 ac-ft/yr (provided that historical and future Buckman Well Field pumping offsets could be met by other sources). These additional flows would enhance streamflow upstream of the diversion by about 4.2 cfs on average from current conditions (i.e., including current San Juan-Chama releases).

Ground water modeling discussed in the section, “Ground Water” of this document shows that adding the direct diversion with reduced pumping from the Buckman Well Field would cause a gradual reduction in the depletions of flow in the Rio Grande that are caused by ground water withdrawals. Depletions of flow from ground water pumping are offset by releases of San Juan-Chama water and a small amount of retired native Rio Grande rights. The ground water/surface water interactions and quantities of depletions are discussed in the section, “Ground Water” with the ground water analysis.

Effects on Sediment Transport and Deposition — The Proposed Action would not have noticeable effects on sediment transport and deposition when compared to the order-of-magnitude type variations that occur seasonally in sediment transport in a natural river such as the Rio Grande. This conclusion is based on hydraulic and sediment calculations for conditions before and after the proposed diversion.

The effect of the proposed diversion facility on flow characteristics and sediment transport in the river downstream of the diversion can be estimated from equations used in hydraulic analysis of river systems. Because the majority of sediment is smaller than can be removed with the proposed sediment separation facility near the point of diversion, the majority of sediment diverted with raw water from the Rio Grande would be pumped up to the WTP where it would be removed and disposed. Therefore, the total sediment load in the Rio Grande would be reduced by operation of

the Buckman Project. Downstream of the proposed diversion, flow depth would decrease slightly and there would be some sediment deposition. The calculations are discussed in the Water Resources Technical Report that was prepared in support of this EIS.

Using hydraulic equations for flow in a river and sediment transport, it is possible to estimate the degree to which the bed level could be adjusted by a slight reduction in flow with and without the return of the sand fraction. From these equations it was estimated that the thickness of the potential deposition immediately downstream of the diversion would typically be less than an inch and confined to an area within a few hundred feet of the diversion. With the variations in a typical natural river channel that could be expected in the Rio Grande, this amount of deposition would be essentially immeasurable. This calculation assumes that coarse sediment would be returned to the river with 4 cfs of carriage water, a feature that is part of the Proposed Action, but would not be returned to the river as one of the sediment facility alternatives. Sediment facility alternatives are discussed later in this document.

As an example, for a flow of 1,000 cfs, the calculations suggest that with the sand return, the deposition downstream of the diversion would be about 0.16 inch and 0.11 inch without the sand return. Neither amount would be noticeable in a natural river channel like that of the Rio Grande that undergoes continual erosion and deposition.

Effects on Water Quality — The Proposed Action could have very minor effects on turbidity, but would not affect any other water quality parameters such as hardness, total dissolved solids, organic constituents or any other constituents that could be present in the river. Naturally present sands with particle sizes coarser than 0.1 mm would be returned to the river; however, since these would be present in the river anyway, this is not considered to be an adverse impact. Re-injection of sand would have little effect on turbidity, since: (1) for most flow conditions it would represent less than 1 percent of the total sand being transported by the river; and (2) higher turbidity levels are normally associated with organic material, dissolved solids, and suspended fine silt and clay particles rather than coarser sand particles. None of the constituents mentioned in item (2) would be affected by the diversion. Since the diversion would not involve effluent discharges or any chemicals, petroleum, or other products that could affect water quality, no other water quality effects have been identified.

Effects on Water Use and Water Rights — The Proposed Action is expected to have a beneficial effect on water use and an indirect effect on water rights. The Buckman Project would allow the applicants to meet their projected demand for water through 2010, and in the case of Las Campanas, through full build-out. Approximately two-thirds of the maximum diversion, including all of the City's portion, would be associated with imported water from the San Juan-Chama Project. Las Campanas has leased rights to supply its requirement. The Proposed Action would have an indirect effect on water rights in that these leases would need to be maintained in order for the community to continue to use water from the diversion. Likewise, the County's 40-Year Water Plan has identified a number of inplace and existing rights including some San Juan-Chama water to satisfy its demand. Leasing or purchasing water rights would be subject to permits and approvals from the OSE that are outside the scope of this document.

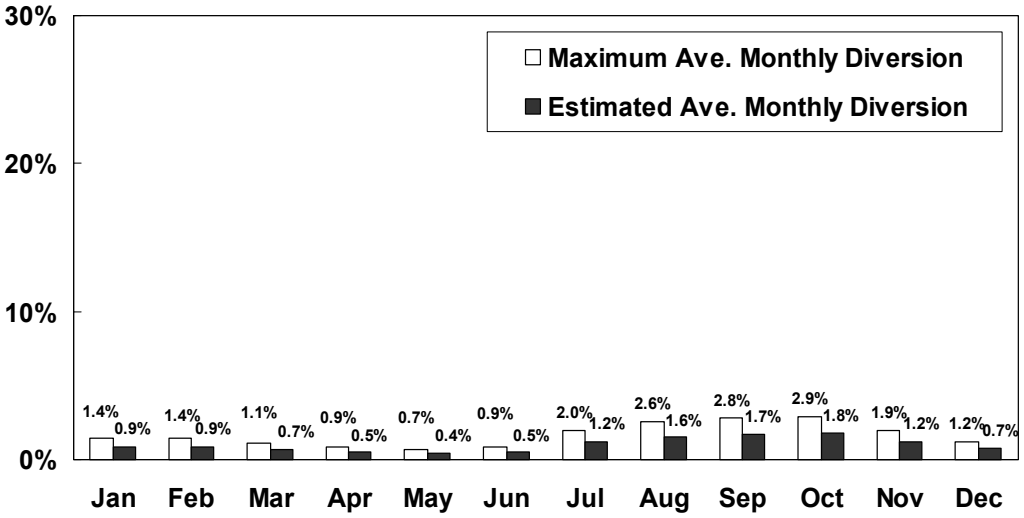

Figure 33. Proposed diversions as a percent of monthly flow at Otowi Bridge (Jan 1963-Sep 2001).

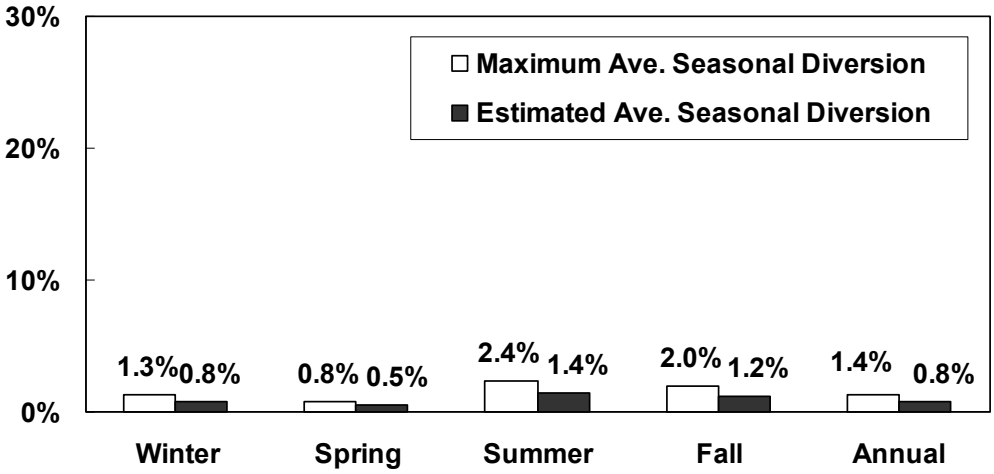

Figure 34. Proposed diversions as a percent of seasonal flow at Otowi Bridge (Jan 1963-Sep 2001).

Effects on Flooding or Flood Plains — The Proposed Action is not expected to affect flooding or the flood plain boundaries. The flood plain boundary is defined by the flow event that would be expected to be equaled or exceeded once every 100 years, or put another way, has a 1 percent chance of occurrence each year. Under such a flow, the diversion structure would be completely submerged. Its small footprint, with respect to the flood plain coupled with its low profile, would have virtually no effect on the flood elevation or the boundary of the flood.

Direct and Indirect Effects of Sediment Facility Alternatives

Construction Effects. Construction effects would be essentially the same as those discussed for the Proposed Action.

Operation Effects. Two sediment handling alternatives were developed, designated SF1 and SF2. Effects on streamflow if Alternative SF1 is selected would be the same as for the Proposed Action. With Alternative SF2, the maximum diversion would be reduced from 32 cfs to 28.2 cfs; however, since there would be no return flow for sand re-injection, the net diversion would still be 28.2 cfs under peak withdrawal conditions. Therefore, the effects on streamflow would be nearly identical to those for the Proposed Action.

Effects on sedimentation, if Alternative SF1 is selected, would be the same as for the Proposed Action. With Alternative SF2, there would be no return flow for sand re-injection; therefore, the effects on sedimentation would be slightly less than for the Proposed Action. However, there would still be some reduction of carrying capacity for sediment transport. Therefore, there would likely still be some localized sediment deposits immediately downstream of the diversion. These deposits would likely be smaller than those associated with the Proposed Action and not measurable.

The effects on water quality for either sediment facility alternative would be similar to those associated with the Proposed Action and would be very minimal. Some temporary increases to turbidity would be expected during construction activities. After completion of construction, turbidity would return to pre-construction levels. The diversion is not expected to affect other water quality parameters. Similarly, no measurable effects to flooding or flood plains would occur.

Water use and water rights effects associated with sediment facility alternatives would be the same as for the Proposed Action.

Direct and Indirect Effects of Pipeline Route Alternatives

Construction and Operation Effects. Several alternate routings of pipelines are being analyzed. With proper construction controls in place, the effects on surface water resources would be the same as the Proposed Action for all pipeline alternatives.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. The effects on surface water resources would be the same as for the Proposed Action for the power upgrade alternative.

Cumulative Effects

Releases of water from the San Juan-Chama Project coupled with the Buckman Project would have some cumulative effect on flows upstream of the project and on storage in the three reservoirs on the Rio Chama, but these effects would be minor. Releases of San Juan-Chama water could be timed to coincide directly with water diversions through the Buckman Project or, if it is deemed beneficial for recreational or ecological purposes, they could be timed to match natural flows in the river channel or for release during low flow periods. The schedule for release of San Juan-Chama water would be determined through a process that would involve the applicants, OSE, and BOR.

The cumulative effect of the diversion, coupled with releases of water from the San Juan-Chama Project, on storage in the reservoirs would be minimal. Abiquiu Reservoir has a capacity of greater than 1.5 million acre-feet with almost 200,000 acre-feet available for storage of San Juan-Chama Project water. On a reservoir of this size, variations in storage over the course of a year of 5,605 acre-feet (i.e., the City and County's combined San Juan-Chama Project annual water allocation) would affect the surface elevation by less than an inch. If releases of San Juan-Chama water were timed to coincide with low flow conditions in the river system, there could be some ecological and recreational benefit to having an extra 10 to 20 cfs in the Rio Chama and the Rio Grande during the late summer above the Buckman site and some additional flow downstream as well. Under such a release scenario, during high flow events in the spring, flows downstream of the diversion would be reduced slightly, but on balance over the year, the City and County would take only their allotment of San Juan-Chama water.

There would be almost no effect of the Buckman Project on flows below Cochiti Dam. Therefore, cumulative effects with projects in the Albuquerque area, including the Albuquerque diversion project are not anticipated. There could be some minor cumulative effects with water right transfers or purchases planned by the County. In the County's 40-Year Water Plan they identify a water right of 71.2 ac-ft/yr that they own in the Socorro area and that they plan to apply for transfer. That amount of diversion would affect flow on average by a minor amount between Otowi and Socorro. A flow of 71.2 ac-ft/yr is about 0.2 cfs or about 0.014 percent of the average flows in the Rio Grande at Otowi.

If a lease for 3,000 ac-ft/yr of water is successfully executed with the Jicarilla Apache Nation, that water will become part of the City's water "portfolio" for the duration of the lease. A primary near-term use of that water would be for depletion offsets. If the City and Jicarilla Apache Nation enter the 3,000 ac-ft/yr lease of the Nation's San Juan-Chama Project water and the lease is approved by the BOR, and if the City determines to divert some or all of the leased water through the Buckman Project, the total diversion would not exceed 8,730 ac-ft/yr or 32 cfs. The lease would not alter the infrastructure or effects described and evaluated in this EIS. The effects of storage of the water by the City would be de minimis given that the City would utilize existing reservoirs consistent with existing reservoir management. The effects of release of the water from Heron would be essentially unchanged from existing conditions as the Nation's water has been released from Heron for various purposes. The release of water from downstream storage would have de minimis effects on flow conditions in the Rio Chama and the Rio Grande. The releases may have a minor beneficial effect by enhancing base flows because water managers could normally make release on a gradual and consistent release schedule consistent with the City's use of the water. Consequently, the cumulative effects of the lease and Buckman Project would not be significant.

Ground Water

The ground water description and discussion provides a general overview of the ground water resources in the study area that could be affected by the project. It also includes an evaluation of the environmental consequences to ground water resources that would be associated with the Buckman Project.

Affected Environment

Ground water is used for municipal water supply, as well as agricultural, domestic, and industrial purposes in the City of Santa Fe (Buckman and City of Santa Fe Well Fields, see Figure 29), Los Alamos, Guaje, Pajarito Mesa, and Otowi Well Fields, the City of Española, and smaller communities such as El Dorado, south of Santa Fe. The Buckman Well Field currently consists of 13 wells that typically are used to supply about 40 percent of the water demand from the City in a normal precipitation year. The wells pump from the Tesuque aquifer, part of the Tertiary-age Santa Fe Group of Rio Grande rift basin-fill sediments. The 5-year (1997-2001) average operational pumping rate for the well field (wells 1 - 8) is approximately 560 gallons per minute per well (gpm/well). The 2001 average operational production for all of the wells (wells 1-8) was 590 gpm/well.

The operation of the Buckman Well Field has resulted in a regional water level decline, known as drawdown of the aquifer. Drawdown from well pumping does not occur uniformly throughout the aquifer. The greatest amount of drawdown occurs in the vicinity of the wells. Less drawdown of the aquifer occurs at locations progressively further from the wells forming what is known as a cone of depression. The cone of depression can also be depicted graphically as a series of concentric rings centered either on an individual well or on an entire well field. Each ring represents a contour interval, much like those used on a topographic map, to depict the shape and depth of the ground water around a well or well field. It is important to characterize the drawdown at varying distances from an individual well or well field so the effects of pumping can be assessed in terms of its effects on reducing the pumping capacity of existing wells, reducing flow of natural springs, or reducing the flow of surface water in local or regional streams.

The measured drawdown within the Buckman Well Field has been approximately 200 feet since 1982. The drawdown (since 1970s prepumping conditions) that is greater than 10 feet, as predicted by a numerical ground water model occurs over a region measuring roughly 1 mile by 0.5 mile within the center of the well field. Drawdown values exceed 300 feet in the portion of the aquifer where most of the pumping occurs, and localized areas (near wells) exceed 340 feet in this same portion of the aquifer. Historical pumping from the Buckman Well Field has led to current annual depletion of flow in the Rio Grande, Rio Pojoaque, and Tesuque Creek, at rates of approximately 2623, 52 and 32 ac-ft/yr, respectively, through 2001 as predicted by the numerical model used by the OSE. Depletions for these rivers and tributaries are offset by water rights owned or leased by the City. Residual offset requirements from Buckman pumping are expected to last for many decades on all rivers and tributaries, even if Buckman well pumping were ceased immediately.

The City of Santa Fe tests the ground water from the Buckman Well Field and provides the information in Annual Water Quality Reports *(http://sfweb.ci.santa-fe.nm.us/waterwise/WaterReport2001a.pdf)*. The City tests for a variety of constituents as required by the Federal Safe Drinking Water Act, such as arsenic, barium, chromium, lead, copper, fluoride, nitrate, and various byproducts of drinking water chlorination. In 2001, with two exceptions, these constituents were measured as nondetectable or below Maximum Contaminant Levels or Maximum Contaminant Level Goals. The two exceptions involved two samples that were slightly above the Action Level for lead. An Action Level is a concentration above which a water provider must take additional steps to reduce point-of-use concentrations of a given compound.

Environmental Consequences

Either the Proposed Action or its alternatives, excluding the No Action Alternative, would be beneficial to regional ground water resources. The diversion would allow for reduced pumping of the Buckman Well Field, which would allow recovery of water levels compared to the current cone of depression. In addition, there is no reason to conclude that the project would have any adverse effect on ground water quality.

No Action Alternative

Ground water flow computer models have been created to estimate the future drawdown and other effects of pumping on the aquifer and surface waters in the Santa Fe basin. A model was developed by Camp Dresser & McKee (CDM) for the City ("City model") for water supply planning that divides the aquifer into nine separate layers defined by their depths and water-bearing properties. The detailed layering used in this model allows the effects of pumping to be described more accurately than it has been by other models developed for the region. Most of the hydrologic data used in this section were obtained from reports produced by CDM (2002a and 2002b), an engineering firm under contract with the City to perform hydrological studies and water supply planning for this project. Data from the modeling effort was also summarized in the Buckman Supplemental Wells Environmental Assessment (Tetra Tech 2003)

The descriptions of the cone of depression presented in this document are based on the effects to the aquifer in Layer 4 of the City model. This layer corresponds to the depth from which most of the Buckman wells pump and is, therefore, the layer in which the largest drawdown effects occur. Layering of geologic deposits in the Santa Fe region's aquifer system causes the cone of depression to spread out laterally within a layer and to dampen out in the vertical direction. Since most domestic wells in the region are shallower than municipal wells, they tap aquifer layers less affected by the Buckman Well Field pumping. The resulting drawdown associated with the Buckman Well Field that is seen in these shallower layers and the associated effects felt by individual domestic wells would, in most cases, be smaller than are described in this section, which is based on effects to the deeper model layer. The drawdown values reported here can thus be considered a reasonable worst-case for most wells.

The cone of depression that currently exists in the vicinity of the Buckman Well Field is the result of pumping water from the well field over the last 30 years (see Figure 35). An average of 5,200 ac-ft/yr of water have been pumped from the Buckman Well Field each year for the period of 1995 to 2001. The pumping of each individual well at Buckman has incrementally contributed to the overall well field cone of depression. In 2001, the depth to ground water at the center of the cone of depression for the Buckman Well Field was approximately 260 feet, as measured in a City observation well located near the center of the well field. This depth to water represents the combined effects of pumping from all private, agricultural, and municipal wells in the region, although it is most strongly influenced by pumping from the Buckman wells. Aquifer drawdown from pumping the Buckman Well Field takes on an irregular shape due to the local topography and influence of the Rio Grande. Modeling indicates that the 10-foot contour interval of the cone of depression, in Layer 4 of the City model, currently extends approximately 4 miles to the west, north, and northeast, 5 miles to the east, southeast, southwest, and northwest, and 6 miles to the south, away from the center of the cone of depression (CDM 2002a) for a diameter of approximately 9 miles. However, the cone of depression at the top of the saturated zone (Layer 1 of the City model) near the ground surface is much smaller.

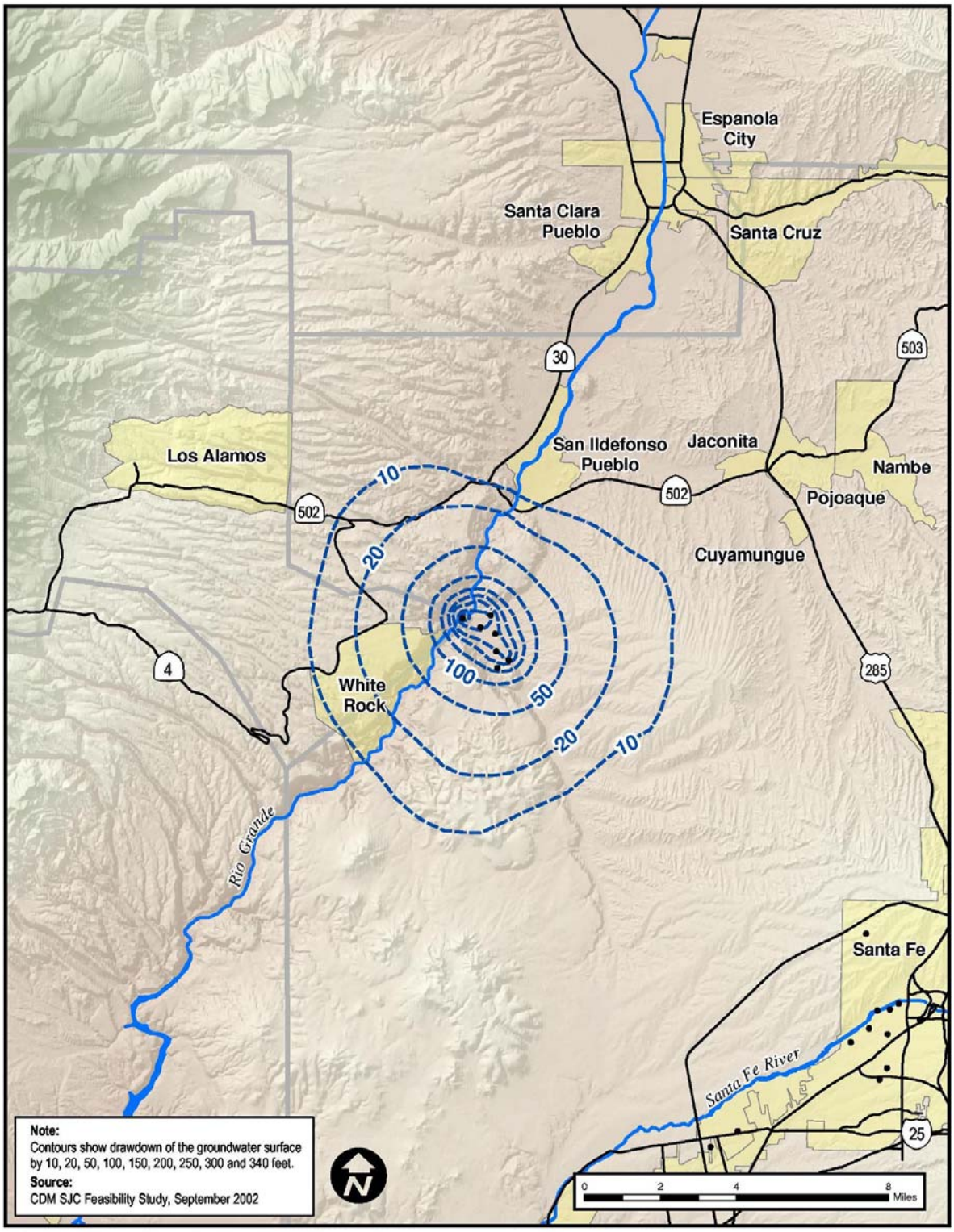

Figure 35. Simulated drawdown from Buckman Wells 1-8 in 2000, ground water layer 4. (Source: CDM – Permit Applicants' Contractor)

As mentioned in the previous section, "Surface Water Resources," under the No Action Alternative for surface water, Buckman Wells would, for planning purposes, continue to be pumped at their most recent 5-year rates through 2060. This alternative would result in continued depletions of the aquifer in the Buckman area and the flows of the Rio Grande and its tributaries—the Rio Pojoaque and Tesuque Creek—and the City would have to continue to provide offsets for these depletions. The effects on the Rio Grande are much more immediate because of its close proximity to the well field. By 2060, within the aquifer layer most directly affected by pumping (Layer 4 of the City model), 10 feet or more of aquifer drawdown from the Buckman Well Field cone of depression would extend approximately 5 miles to the north, 7 miles to the northeast and southwest, 8 miles to the east and southeast, 11 miles to the south, and to the boundary of the aquifer to the west and northwest, away from the center of the cone of depression. At the water table surface, however, the drawdown values would be much smaller.

According to the results of computer modeling, by 2010, pumping Buckman wells would cause the center of the cone of depression to be approximately 400 feet deep (CDM 2002b), which represents an increase in depth of 140 feet from 2001 to 2010. The model indicates that with the passage of time, the average annual increase in the depth of the center of the cone of depression would decrease to less than 2 feet per year in the 2010-2060 interval.

The effects of pumping from the Buckman wells on stock water wells in the area under this alternative were modeled by CDM (2002b). Because the actual pumping rates for the stock water wells are unknown, it is not possible to predict the effect that drawdown of the aquifer would have on yields. It is, however, possible to predict drawdown resulting from operating the Buckman Well Field as described under this alternative. Ultimately this tells us very little about whether or not a particular stock water well would be affected under the No Action Alternative because a low output well would not require more than a few feet of saturated thickness (the distance between the bottom of the well and the static ground water level), but it does provide a basis of comparison for the Proposed Action. A typical stock water well only pumps a few gallons per minute, which does not require a large saturated thickness, so the output of some of the wells that are expected to experience a high degree of drawdown from the operation of the Buckman Well Field would not be affected much, if at all. Alternatively, a well with a very high output may be severely affected by a small reduction in its saturated thickness. The effects of an action are described here in terms of the reduction in the saturated thickness for a given well. A reduction in saturated thickness in a well of greater than 70 percent is generally considered to be an adverse effect. When using this criterion, computer modeling indicates that six stock water wells would probably be adversely affected by 2060 (with all 13 Buckman wells online).

The operation of Buckman Wells 10-13 under the No Action Alternative scenario will result in continued depletions of the aquifer in the Buckman area and the flows of the Rio Grande and its tributaries—the Rio Pojoaque and Tesuque Creek—as discussed in the section, "Ground Water, Affected Environment." The effects of pumping ground water at Buckman would continue to be observed on the Rio Grande and its tributaries. The effects on the Rio Grande are much more immediate because of its close proximity to the well field. By 2060, with all 13 Buckman wells operating within the aquifer layer most directly affected by pumping (Layer 4 of the City model), 10 feet or more of aquifer drawdown from the Buckman Well Field cone of depression would extend approximately 6 miles to the north, 6 miles to the northeast and southwest, 8 miles to the east, 12 miles to the southeast, 13 miles to the south, 8 miles to the southwest, and to the boundary of the aquifer to the west and northwest, away from the center of the cone of depression. At the water table surface, however, drawdown values would be much smaller.

Table 11. Cumulative effects of the Buckman Well Field on the regional aquifer.

	Distance to 10-Foot Contour Interval from the Center of the Buckman Well Field Cone of Depression (mi)							
	N	NE	E	SE	S	SW	W	NW
Existing Condition (2000)	4	4	5	5	6	5	4	5
No Action in 2060 with Wells 1-9	5	7	8	8	11	7	AB	AB
No Action in 2060 with Wells 1-13	6	6	8	12	13	8	AB	AB
Proposed Action with Wells 1-13 in 2060	3	4	5	8	6	3	4	4
Incremental Effect of Prop. Action in 2060	-3	-2	-3	-4	-7	-5	<-2	<-2

AB = Aquifer Boundary.

Note: Drawdown as predicted by the City's numerical ground water flow model, using results from the model layer in which the largest amount of Buckman Well Field pumping occurs. (Source: Tetra Tech 2003)

Additional details concerning the effects of Buckman Wells 10-13 in the Buckman Well Field can be found in previous reports (CDM 2002b) and in the Buckman Supplemental Wells Environmental Assessment (Tetra Tech 2003).

Direct and Indirect Effects of the Proposed Action

Construction Effects. Ground water, particularly the deep ground water aquifers that are used for water supply, would not be affected by construction of the Proposed Action because the applicants would continue to use their regional water supply sources as they would under the No Action Alternative until construction is complete.

Operation Effects. The proposed Buckman Project is expected to become operational in late 2006 or early 2007. This project would allow the City and County to withdraw their allotment of San Juan-Chama water directly from the Rio Grande. At that time, pumping from the Buckman Well Field would be scaled back to a long-term average of approximately 1,000 ac-ft/yr. The effects of operating the Buckman Well Field in conjunction with the direct diversion have been modeled by CDM (2002b). The model results show that the shift to the direct diversion would result in a gradual rebound of the aquifer water levels coupled with a decrease in the extent of the cone of depression, especially when compared to the effects of continued ground water pumping through 2060.

Table 11 shows the projected effects of reduced pumping on the extent of the cone of depression based on the City's ground water flow model, described previously. The distance to the 10-foot contour of the cone of depression has, therefore, been assumed to provide a reasonable practical boundary. Table 11 shows the distance to the 10-foot contour for existing conditions and for future conditions for the No Action Alternative with and without four planned new wells and the Proposed Action. In 2060, the projected total distance across the cone of depression from north to south is projected to be 19 miles (6 miles north and 13 miles south) without the Proposed Action, and only 9 miles with the Proposed Action.

By 2060, offset requirements on the Rio Grande from reduced Buckman well pumping are projected to be equal to approximately 677 ac-ft/yr, which represents 1,946 ac-ft/yr less than the current (2001) situation and would be approximately 3,830 ac-ft/yr less than would occur in 2060 under the No Action Alternative with 13 wells in place. Similar results would occur in the Rio Pojoaque and Tesuque Creek. Table 12 provides a summary of calculated offset requirements for the Rio Grande and its tributaries.

A comparison of stock water well depths, original depths to ground water in those wells, and the anticipated cumulative drawdown effects from pumping all 13 Buckman wells for each year through 2060 was conducted by CDM (2002b) to determine if any of the stock water wells might be adversely affected. To maintain a consistent reference for the comparison of effects, the cumulative effects are evaluated in terms of saturated thickness. A reduction in saturated thickness of 70 percent or more is considered an adverse effect. No stock water wells are expected to be adversely affected by pumping all 13 wells at Buckman either by 2006 or by 2060 if the direct diversion is in place. Further details are provided in CDM (2002b) and the Supplemental Wells EA (Tetra Tech, Inc. 2003).

Direct and Indirect Effects of Sediment Facility Alternatives

Construction and Operation Effects. The effects on ground water for the sediment facility alternatives would be the same as those associated with the Proposed Action.

Direct and Indirect Effects of Pipeline Route Alternatives

Construction and Operation Effects. The effects on ground water for the pipeline route would be the same as those associated with the Proposed Action.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. The effects on ground water for Alternative AGP1 would be the same as those associated with the Proposed Action.

Table 12. Comparison of direct and cumulative effects to surface water resources. (Source: Tetra Tech 2003)

	Required San Juan-Chama Offsets to Rio Grande[a] (ac-ft/yr)	Estimated Offsetting Water Rights in the Rio Pojoaque (ac-ft/yr) [b]	Estimated Offsetting Water Rights in Tesuque Creek (ac-ft/yr)	Approximate Center Depth of Cone of Depression (feet)	Well Field Production (ac-ft/yr)
Existing Conditions (2001)	2,623	48	12	260	5,200
No Action in 2060 with Wells 1 – 13	4,507	327	167	500	10,000
Proposed Action with Wells 1 – 13 in 2060	677	71	40	60	1,000[c]

[a] The City's permit from the Office of State Engineer to operate the Buckman wells states that operation of the Buckman Well Field shall not cause a depletion of the flow of the Rio Grande. San Juan-Chama water stored in upstream reservoirs is released to offset depletions of water in the Rio Grande that result from pumping ground water from the Buckman Well Field. Because of this, the Rio Grande experiences no reduction of flow from operation of the Buckman Well Field.

[b] The City has purchased water rights in the Rio Pojoaque and Tesuque Creek to compensate for flow reductions experienced in these tributaries as a result of pumping ground water from the Buckman Well Field. Because the cumulative effect of operating the existing nine wells at Buckman and the proposed direct diversion after 2006 would eventually result in depletions that exceed the City of Santa Fe's water rights in the Rio Pojoaque, the City is presently studying additional means of offsetting future depletions in the Rio Pojoaque.

[c] Production from Buckman Well Field beginning 2008 under normal operation conditions.

Cumulative Effects

The response of ground water levels to reduced pumping of the Buckman Well Field, coupled with surface diversion from the Rio Grande, can be considered to be a cumulative effect. The City is currently required to offset or mitigate depletions of flows in the Rio Grande and the Nambe, Tesuque, Pojoaque river system that occur as a result of pumping from the Buckman Well Field. After switching to use of the diversion, even with substantially reduced pumping from the wells, the City would be required to provide residual offsets of flows from past pumping from the Buckman Well Field. Future offsets would be provided from releases of currently stored San Juan-Chama water, leased or purchased San Juan-Chama water, native water, or currently owned native water rights. The offset amount is currently about 2,600 ac-ft/yr and would decrease in the future as Buckman well pumping would be decreased when the diversion would come online. Once the diversion is online, the required Rio Grande offsets for Buckman Well Field pumping (historical and future) would be met through one or more of the following:

- Existing City-owned native Rio Grande rights
- Releases of previously stored San Juan-Chama water from upstream reservoirs
- Lease or purchase of additional San Juan-Chama or native Rio Grande water

No other projects that would affect ground water within the aquifer are reasonably foreseeable. Therefore, no other cumulative effects have been identified at this time.

Biological Resources

The following analyses address the plant communities and wildlife present in the project area and the likely effects that would occur from implementation of the proposed project and alternatives. The primary areas of effect are the diversion site at the Rio Grande, Buckman Road improvements, all associated treatment and pumping facility sites, and pipeline corridors. Conditions and potential effects to aquatic species are addressed for the local Rio Grande reach directly adjacent to the proposed water diversion site. The Rio Grande reach from Cochiti Dam to the headwaters of Elephant Butte Reservoir potentially inhabited by the Rio Grande silvery minnow is addressed in the section, "Rio Grande Silvery Minnow," later in this chapter.

Terrestrial Communities

Affected Environment

Plant Communities. Two major plant communities occur within the project region—the Flood Plains-Plains Riparian along the Rio Grande and the Juniper Savanna, which encompasses most of the remaining area (Dick-Peddie 1993). Both of these communities have been altered, to various extents, from their natural composition and stature by a range of disturbances including suppression of naturally occurring fires, surface developments, livestock grazing, off-road vehicle use, reduced surface water flow, and the invasion of exotic plant species. The Juniper Savanna is characterized by a relative low density of trees (130 per acre) within grassland. The canopy of this region is generally open, except for scattered clusters of closely spaced trees, particularly in the Diablo Canyon area and hillsides. This community type has been expanding throughout New Mexico over the last 150 years—grasslands have been altered or lost in response to intensive grazing; and the frequency and intensity of fires has been dramatically decreased. Within the project area, the ground cover is approximately 60 percent and generally does not support the fine fuels (herbaceous plants) necessary to carry a wildfire. Within the proposed project locale, elevations range from 5,700 feet at the Rio Grande to 6,500 feet at the Airport Road terminus.

Near the diversion point at the Rio Grande, vegetation consists of a dense, narrow band of mixed native and nonnative riparian vegetation. Woody species in this area include saltcedar (*Tamarix ramosissima*), cottonwood (*Populus deltoides*), Russian olive (*Elaeagnus angustifolia*), and coyote willow (*Salix exigua*). Major components of the understory are forbs and grasses such as field mint (*Mentha arvense*), spreading dogbane (*Apocynum cannabinum*), and fescue grass (*Bromus catharticus*). As the proposed project route progresses inland, vegetation changes somewhat to include plants that are only partially dependent on near surface ground water. These plants include New Mexico olive (*Forestiera neomexicana*), sweet clover (*Melilotus officianalis, M. alba*), New Mexico locust (*Robinia neomexicana*), camphorweed (*Heterotheca subaxillaris*), and lemonade bush (*Rhus trilobata*). Within the project corridor, and southeast of the riparian and semiriparian areas along the Rio Grande, is the flood plain of the lower Cañada Ancha. This area

is subjected to intense pressure from cattle grazing and human activities such as off-road driving, refuse dumping, and camping. This broad, open flood plain is dominated by rabbitbrush (*Ericameria nauseosa, E. depressus*) and the ubiquitous disturbance shrub, snakeweed (*Guttierezia sarothrae*). Other plants in this association include Apache plume (*Fallugia paradoxa*), four-wing saltbush (*Atriplex canescens*), and two species of globemallow (*Sphaeralcea angustifolia, S. incana*).

Once out of the flood plain, the pipeline route enters the Savanna community where one-seeded juniper (*Juniperus monosperma*) becomes the most common tree species. Other woody vegetation includes piñon pine (*Pinus edulis*), yucca (*Yucca glauca*), tree cholla (*Opuntia imbricata*), sand sage (*Artemesia filifolia*), and rabbitbrush. Since the site-specific vegetation survey was conducted for this proposal, there has been substantial die-off of piñon pine in the area. Mortality of piñon pine is the result of drought and infestation of bark beetle. Approximately 60 to 90 percent of the piñon pine in the project area is either dead or dying.

At Dead Dog Well the pipeline corridor splits, with one route continuing southeast toward Las Campanas. Within the low density residential area of Las Campanas, and removed from grazing pressure, the pipeline corridor contains many more forbs and grasses. Plants encountered in this area include winterfat (*Krascheninnikovia lanata*), blue grama (*Bouteloua gracilis*), side-oats grama (*Bouteloua curtipendula*), peppergrass (*Lepidium montanum*), sweet clover, and annual wildflowers such as yarrow (*Achillea millefolium*), Palmer's penstemon (*Penstemon palmeri*), and coneflower (*Ratibida columnifera*).

The other leg of the route continues south at Dead Dog Well and follows a utility corridor to the proposed MRC WTP and continues into the City of Santa Fe. The first mile of this route has little ground cover because of its proximity to a cattle watering and holding area. Shrubby plants such as saltbush, rabbitbrush, and snakeweed are the most common species in this area. Farther along the utility corridor, juniper, piñon pine, and yucca dominate, while grama grasses are found in scattered clumps in the understory. The treated water pipeline routes from the MRC to Booster Station 3 all support similar vegetation communities previously described. Once reaching Caja del Rio Road, the proposed pipeline route follows along the western edge of the road ROW to the Highway 599 frontage road, where it again forks into two separate routes. The eastern distribution route follows Caja del Rio Road for three-quarters of a mile before it crosses Highway 599. From this point, it follows two-track roads and dirt easements south across the ephemeral Santa Fe River where it intersects with an existing water distribution system at Airport Road. Though fairly common throughout the entire project area, weedy species particularly dominate the savanna south of Highway 599. Plants in this area include juniper, sunflower (*Helianthus annuus*), gumweed (*Grindelia nuda*), weed verbena (*Verbena bracteata*), kochia (*Kochia scoparia*), nightshade (*Solanum elaeagnifolium*), and grasses such as three-awn (*Aristida longiseta*) and bluestem (*Andropogon gerardii*). Plant species at the crossing of the Santa Fe River are limited to a few small saltcedar, Siberian elm (*Ulmus pumila*), and coyote willow.

The western distribution route follows the western edge of Highway 599 to connect with existing County water pipelines located at the intersection of the I-25 frontage road and Erica Road. The route traverses through disturbed industrial areas and roadway ROWs that support little native vegetation. Conditions and vegetation communities observed on this leg are similar to those on the eastern distribution leg. Sunflowers, gumweed, three-awn grass, bluestem, Russian thistle, Siberian elm, nightshade, and weed verbena were encountered along this route. Species at the

Santa Fe River crossing include saltcedar, coyote willow, Siberian elm, and a few cottonwood saplings.

There are two general types of washes encountered along the proposed project route. The first type is the low lying wash that has not been subjected to recent flash floods. These have denser stands of vegetation, including juniper and rabbitbrush, than surrounding upland areas. The second type of wash is the sandy, open, scoured arroyo. These areas support relatively few plants and only annuals such as scurfpea (*Psoralidium lanceolatum*) and clammyweed (*Polanisia dodecandra*) were found.

Nonnative Invasive Plant Species. Nonnative invasive species of plants and animals are emerging worldwide as one of the leading threats to native species, ecosystem processes, and biodiversity. The introduction of nonnative invasive species can result in the elimination of native species through predation, competition, genetic modification, and disease transmission. Three classes of invasive weeds have been delineated in New Mexico. Class A weeds are those which are not native to an ecosystem and have a limited distribution. Class A weeds receive the highest priority for attention, since their limited distribution provides potential for success in removing current infestations and preventing future spread. Weed species that have yet to invade New Mexico are also labeled as Class A weeds. Class B weeds are not native to the ecosystem in which they occur and are limited to specific areas in New Mexico. Management emphasis is given to containing these weeds to their current range and keeping such plants from spreading into new areas. Class C weeds are nonnative to the ecosystem in which they occur but are widespread throughout New Mexico. The development of long-term programs which deal with the management and suppression of these invaders are necessary to achieve any degree of success. Nonnative invasive plant species present along with their New Mexico designation, if any, within the project area include: Canadian thistle (*Cirsium arvense*) – Class A; cheatgrass (*Bromus tectorum*), dalmatian toadflax (*Linaria genistifolia* spp. *dalmatica*) – Class A; yellow toadflax (*L. vulgaris*) – Class A; Russian thistle (*Salsola kali*), Siberian elm (Ulmus pumila) – Class C; salt cedar – Class C; and Russian olive – Class C. The Santa Fe National Forest is analyzing a proposal to control, contain or eradicate invasive plant species throughout the forest. The draft EIS for that project was released to the public in June 2004.

Wildlife. Because of previous and existing effects from alteration of the natural fire regime, livestock grazing, developments, and other human uses, the proposed project area does not support high quality nesting, denning, foraging, or hunting habitat for wildlife other than reptiles (i.e., snakes and lizards). At the Rio Grande water diversion site the quality of riparian wildlife habitat is reduced due to the presence of primarily nonnative species, such as salt cedar and Russian olive, and disturbance by human activities (i.e., shooting, off-highway vehicle use, and assemblage of weekend partygoers). It should be noted that in New Mexico, at least 80 percent of all animals use riparian areas at some stage of their lives, with more than half of these considered to be riparian obligates (BLM 1999). Additionally, the Rio Grande is a main corridor for migratory birds moving from wintering grounds to breeding grounds and vice versa. Higher quality habitat is present both upstream and downstream of the proposed diversion site. These areas could provide suitable habitat for a more diverse population of avian species such as the southwestern willow flycatcher (*Empidonax traillii extimus*) and yellow-belled cuckoo (*Coccyzus americanus occidentalis*).

Inland from the Rio Grande, the area is habitat for a variety of bird species, including raptors and small game animals, such as jackrabbits *(Lepus californicus)*. However, these species generally

do not occur in high enough numbers for the area to be considered an important game region. Large game species, such as mule deer (*Odococoileus hemionus*), are present. However, the project area does not contain any critical seasonal denning or foraging areas. It has been suggested that frequent disturbances, such as firearms discharges, within the vicinity of the proposed project area have reduced the number of species utilizing the area (Orr 2002). Within the City of Santa Fe there is an isolated and small colony of Gunnison's prairie dogs (*Cynomys gunnisoni*) along South Meadow Road at the southwest terminus of the pipeline. There were no prairie dog den sites within the previously graded pipeline ROW during the time of the project specific biological survey conducted in August 2002. Mammalian species that could be expected to utilize all undeveloped habitats are representative of the region. These species include: mule deer, raccoon (*Procyon lotor*), coyote (*Canis latrans*), jackrabbit, cottontail rabbits (*Sylvilagus* species), woodrats (*Neotoma ssp*.), and deer mice (*Onychomys ssp*.). Predatory species would include: black bear (*Ursus americanus*), coyote (*Canis latrans*), fox (*Vulpes* species), mountain lions (*Felis concolor*), and skunks (*Mephitis* species). Human activities and hunting pressure within the Rio Grande corridor have kept large and predatory mammal populations at fairly low levels. However, this region is still a very important refuge for large and small mammals in New Mexico (BIA 2000).

Environmental Consequences

The following methodology and assumptions were used to calculate the number of acres temporarily or permanently affected by implementation of the Proposed Action or alternatives. Table 1 contains more detailed information regarding surface area disturbance calculations.

Permanent loss of vegetation communities and wildlife habitat would occur with the construction of the diversion structure, Buckman Road improvements, sediment facility and associated Booster Station 1A, MRC WTP and associated Booster Stations 4A and 5A, Las Campanas WTP and pipelines, and Booster Stations 2A and 3A. The area occupied by the new structures or areas fenced or converted to other uses would result in the loss of approximately 59 acres. Acreage affected by pipeline construction is considered a temporary effect to biotic communities because the plant communities would be allowed to recover after construction is completed. Temporary loss of vegetation communities and wildlife habitat would occur within the work limits for the construction of the diversion structure, Buckman Road improvements, sediment facility and associated Booster Station 1A, MRC WTP and associated Booster Stations 4A and 5A, Las Campanas WTP, Booster Stations 2A and 3A, and all associated pipelines. The area temporarily affected would be approximately 247 acres. It should be noted that while these areas would be allowed to revegetate either through a project specific revegetation program or allowed to revegetate naturally, tree reestablishment would not be allowed within the pipeline corridors due to maintenance considerations. However, the ecological function of the area would largely revert back to pre-construction conditions.

Total acreage potentially affected by the Proposed Action is 306 acres of which 59 acres would be permanently lost and 247 acres temporarily affected. These are the acreage figures that will be used to compare the effects from the Proposed Action to other project alternatives.

No Action Alternative

Under this alternative there would be no construction or operation of the diversion structure, Buckman Road improvements, booster stations, WTPs, and pipeline conveyance system. There would be no loss or modification of vegetation communities and wildlife habitat.

Direct and Indirect Effects of the Proposed Action

Plant Communities

Construction Effects. Loss of vegetation would occur as a result of the construction activities for the diversion structure, Buckman Road improvements, booster stations, WTPs, and pipeline conveyance system. Construction of the intake structure, booster stations, Las Companas pipelines, and WTPs would result in the permanent loss of approximately 59 acres of vegetation. Additionally, modification or clearing of vegetation for facility work area construction boundaries and preparation of pipeline corridors would likely affect an additional 247 acres. The proposed treated water pipeline would result in vegetation clearance or alteration to approximately 17 acres of the 247 acres (based on a 40-foot construction corridor and a pipeline length of 18,113 feet). For these areas temporarily disturbed, the vegetation would be reestablished through the native plant revegetation program and, therefore, represents a potential short-term affect (see further discussion below under "*Operation Effects"*). Construction disturbed areas, not lost to facilities or other infrastructure, could have a minor increase in plant diversity and density; as the barren and hard soil conditions would be loosened and the surface roughened creating favorable colonization sites. The proposed mitigation to conduct, prior to construction, a survey for invasive plants species and, where found, their eradication would serve to minimize or prevent establishment of invasive plants due to construction-altered habitat. Eradication of invasive plants would be performed through use of mechanical and/or chemical control methods. The Santa Fe National Forest prepared a draft EIS that addresses weed control methods. The final "Weeds" EIS and Record of Decision will be published in late 2004 or early 2005. All weed control methods for the Buckman Water Diversion Project on FS lands would be compliant with the stipulations and guidelines presented in the Weeds EIS Record of Decision, and for BLM lands, Executive Order 13112 Invasive Species along with the National Invasive Species Council's National Management Plan for Invasive Species.

Operation Effects. Arguably, the most severe potential effect of the project is the opportunity for nonnative invasive species expansion in construction-affected areas. Through implementation of the native plant revegetation mitigation program, nonnative invasive species such as salt cedar, Russian olive, and Dalmatian toadflax would have a reduced influence in the areas where project construction activities occur. At the Rio Grande diversion site, which is characterized by a dense, narrow band of mixed native and nonnative riparian vegetation, revegetation with cottonwood and coyote willow would improve the local and native riparian communities. Short-term revegetation success is highly probable at the Rio Grande diversion site due to near surface water availability. However, long-term success may not occur given the highly invasive and opportunistic nature of these nonnative and invasive plant species unless: salt cedar and Russian olive are eradicated in areas closely adjacent to the diversion site; a monitoring and re-establishment prevention program is conducted for several years; and the area is managed to prevent effects to vegetation and soils from human activities (i.e., no vehicle use or camping in areas undergoing revegetation). These long-term success factors would be incorporated as stipulations of the special use permit.

Similarly, implementation of the native plant revegetation mitigation program that includes eradication of nonnative invasive species, such as toadflax, in other project-affected areas would result in stabilizing and improving the plant diversity and health of existing plant communities. However, for successful implementation of the native plant revegetation program, climatic conditions have to be favorable (frequency and quantity of rain), domestic grazing controlled, and the area managed and protected from other inappropriate uses (off-highway vehicles) until the area successfully revegetates. Even with less than full success, the use of mulch coupled with the re-establishment of some plant cover will provide a level of protection against wind and waterborne soil erosion. These practices would retain favorable circumstances for plant germination and growth when climatic conditions are favorable.

Implementation of Buckman Road improvements may have minor but beneficial effects to watershed health (see section, "Geology and Soils, Affected Environment" later in this chapter). Better storm water distribution and decreased erosion could result in increased vegetative cover in some areas downslope of Buckman Road. While speculative, the road improvements could result in more visitation and use of the area resulting in increased pressures on natural resources.

Wildlife

Construction Effects. Approximately 306 acres of wildlife habitat would likely be temporarily or permanently affected during construction. Two hundred seventy-nine acres of construction-affected habitat would be allowed to revert back to its previous condition. During site clearing activities, highly mobile wildlife species or wildlife species with large home ranges (such as deer and birds) would be able to relocate to adjacent undeveloped areas. However, successful relocation may not occur due to competition for resources to support the increased population and the carrying capacity limitations of areas outside the proposed development. Species relocation may result in additional pressure to lands already at or near carrying capacity. The effects could include overgrazing (in the case of herbivores), stress, and over-wintering mortality. For less mobile species (reptiles, amphibians, and small mammals), direct mortality could occur during the actual construction event or ultimately result from habitat alteration. These effects would be minor given the amount of habitat affected compared to available habitat. No species population is expected to be adversely affected.

Operation Effects. Implementation of the native plant revegetation program, soil protection techniques, and wildlife mitigation measures would serve to minimize the long-term effects to wildlife habitat. Implementation of Buckman Road improvements, while resulting in a very minor decrease in habitat, may have a small but beneficial effect to watershed health thus resulting in improved wildlife habitat. While speculative, roadway improvements could result in an increase in visitor use thus potentially affecting wildlife use and behavior in the project area.

Successful implementation of the revegetation control program would result in improvement to riparian habitat along the Rio Grande and provide minor habitat improvement elsewhere in the project region. Additionally, the soil and wildlife mitigation stipulations to: mulch one-seed juniper and piñon pine that are removed; lop and scatter of larger diameter branches and tree trunks for mitigating soil erosion; and for wildlife benefit, consolidate tree material into dispersed (or otherwise removed from the general vicinity of construction and human disturbance) slash piles no higher than 2 feet would, over the long-term, improve the general wildlife habitat in the local area. The 59 acres converted to facilities and other infrastructure would be permanently lost as potential predator hunting habitat and foraging or hiding cover for other wildlife species.

Given the current hard pack soil conditions there is little opportunity for colonization by new plants. Ground disturbance, as a result of construction activities primarily associated with pipeline burial, should produce more favorable conditions for rodents to establish new burrows, and an increased prey base in some areas. However, there would be a concurrent decrease in quality of the habitat immediately adjacent to facilities due to increased noise levels, traffic, lights, and other human activity. The adjacent habitat also would experience a loss of quality from the reduction in size, segmentation of the habitat, and restriction on mobility for some species (Kelley and Rotenberry 1993). These effects, however, would be minor and no species population would be adversely affected.

Direct and Indirect Effects of the Sediment Facility Alternatives

The construction and operation effects are similar to the Proposed Action with the following exceptions.

Construction Effects. Alternatives SF1 and SF2 would require construction in a primarily piñon pine/juniper community compared to a degraded grassland/forb community under the Proposed Action. Alternative SF1 sediment return line would be longer and, compared to the Proposed Action, would result in the short-term disturbance of approximately 3 additional acres. Short-term effects from construction of a return pipeline would be avoided under Alternative SF2 as the coarse sediment would be hauled by truck to the Caja del Rio Landfill instead of returned to the Rio Grande (aquatic organism effects are discussed in the previous section, “Terrestrial Communities”).

Operation Effects. Alternative SF2 would require trucking out sand from the sediment facility. Episodic and increased truck traffic could result in short-term wildlife avoidance of the Buckman Road corridor. However, the effects would be negligible and of short duration and over time the wildlife populations would habituate to changes in road traffic.

Direct and Indirect Effects of the Pipeline Route Alternatives

The construction and operation effects are similar to the Proposed Action with the following exceptions.

Construction and Operational Effects. Alternative TWP1 would require construction and operation of the treated water pipeline in a new ROW corridor along BLM and Las Campanas lands. Approximately 17 acres would be affected by construction of Alternative TWP1, which is about the same as the Proposed Action. Alternative TWP2 would install the treated water pipeline back along the Dead Dog Well corridor and then cut east and would affect approximately 20 acres, some of which would be in a new ROW corridor. Alternative TWP3 would use approximately 27 acres of existing utility line ROW. Construction and establishment of a new pipeline corridor or construction in an existing corridor would result in the minor and short-term removal of vegetation and subsequent reduction in the foraging, hunting, and cover habitat for wildlife. The construction-affected areas would be revegetated. However, establishment of trees in the pipeline corridor would be prevented due to maintenance considerations. Additionally, development of a new corridor could encourage increased recreational use in the area and subsequent degradation to vegetation and wildlife habitat.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. Alternative AGP1 effects would be similar to the Proposed Action for the power upgrades at the Buckman transformer station. Land would be required for either of the new substation sites for construction and operation. This acreage would be converted from existing plant communities and wildlife habitat to an area occupied by facilities and landscaping.

However, avian mortality does occur as a result of electrocution and collision with power lines. The New Mexico Avian Protection Working Group was formed in early 2002 to address this issue in New Mexico. Founding members include representatives from PNM, the Rural Utility Services, Hawks Aloft, the New Mexico Falconers Association, and the U.S. Fish and Wildlife Service (FWS). Their goal is to work cooperatively with New Mexico utilities to voluntarily reduce impacts to raptors and other migratory birds by utilizing more cost efficient methods to obtain data, and identify and address problem areas in New Mexico. Additionally, in July 16, 2003 the FWS issued a press release announcing that new voluntary guidelines for protecting birds from electrocution and collisions with power lines are now being developed by the FWS and the Avian Power Line Interaction Committee that promise improved safeguards for migratory birds. Electrocutions and line strikes are a particular threat to birds with large wingspans, such as eagles, hawks, and owls—all species protected under the Migratory Bird Treaty Act. Avian interactions with power lines also cause power outages, which represent added cost and inconvenience for electric utilities and their customers. The new guidelines will give electric utilities a framework to use in developing a voluntary Avian Protection Plan tailored to their specific operations. The Avian Protection Plan guidance document, which will be published on the FWS and Avian Power Line Interaction Committee Web sites, will reference the latest industry standards for preventing avian power line interactions, including recommendations from the most current edition of Avian Power Line Interaction Committee "Suggested Practices for Raptor Protection on Power Lines." Should the power upgrade alternative (AGP1a or AGP1b) be selected, then the FS and BLM would recommend the power line be constructed to be compatible with the current Avian Power Line Interaction Committee (APLIC) "Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996" and FWS guidelines for protection of avian species from electrocution and line strike.

Cumulative Effects

Under the Proposed Action and alternatives there would be a permanent loss of approximately 59 acres which would be additive to the continuing habitat loss within lands contiguous with or in close proximity to the Buckman Project area in Santa Fe, Rio Arriba, and Los Alamos Counties, as well as, San Ildefonso Pueblo lands. Habitat loss is primarily a result of new road construction (NM 284/85), housing development, and increasing recreation use of public lands.

Aquatic Communities

Affected Environment

Aquatic habitat at the proposed Rio Grande diversion site consists of main channel runs and limited pool habitat. Gravel and cobble riffles and bars are located upstream and downstream of the proposed project site.

Fish sampling (electro-shock) was conducted in August 2002 adjacent to the diversion site in the eddy, shoreline run, and mainstem run habitats. Silt, sand, gravel, cobble, boulder, and vegetation substrates were sampled. All fishes were identified and measured before being released.

A total of seven fish species—brown trout (*Salmo trutta*), white sucker (*Catostomus commersoni*), common carp (*Cyprinus carpio*), flathead chub (*Platygobio gracilis*), longnose dace (*Rhinichthys cataractae*), channel catfish (*Ictalurus punctatus*), and smallmouth bass (*Micropterus dolomieui*)—were captured during the sampling effort. Of these seven species, only the flathead chub and longnose dace are considered native to the Rio Grande in New Mexico. The white sucker and flathead chub were the most abundant fish collected. Review of available literature related to past fisheries sampling indicates that the sampling effort collected all species documented for the project area with the exception of Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*), Rio Grande sucker (*Catostomus plebeius*), and the Rio Grande chub (*Gila pandora*). The Rio Grande cutthroat trout prefers clear, silt-free water in cold streams and lakes with gravel beds, and the Rio Grande sucker is rarely found in waters with heavy loads of silt and organic detritus. Thus, both species are highly unlikely to inhabit the project area. The Rio Grande chub prefers impoundments and pools of small to moderate streams and is frequently associated with aquatic vegetation. It may be an infrequent component of the fish population in the project area. Similar sampling results were obtained from a fisheries inventory at San Ildefonso that identified white sucker, common carp, brown trout, longnose dace, flathead chub, and channel catfish (BIA 2000).

None of the species captured in this stretch of the Rio Grande have drifting eggs. However, two of the species collected—white sucker and longnose dace—do have drifting larvae. The opinion of project aquatic biologists is that these drifting larvae are relatively large and are probably able to control their movements to some extent.

No amphibians, including tadpoles (immature aquatic life stage for frogs and toads), were observed during the field survey conducted specifically for the Buckman Project. Field survey locations included the bank, pool habitat, and main channel of the Rio Grande at the water diversion site. Water velocities in the main channel are too high to meet habitat requirements for relatively poor swimming tadpoles. No appropriate frog habitat exists inland of the Rio Grande within the project area.

Environmental Consequences

No Action Alternative

Under this alternative there would be no construction or operation of the water diversion structure, booster stations, sediment facility, and associated return flow pipeline. Therefore, there would be no effects from construction of a cofferdam and no modification or loss of aquatic habitat and adjacent riverside vegetation.

Direct and Indirect Effects of the Proposed Action

Construction Effects. During cofferdam construction and demolition, localized increases in turbidity would occur. Aquatic fauna in the area would be temporarily affected during these activities. Aquatic fauna would be expected to temporarily vacate the locality of increased turbidity. Benthic invertebrates (primarily aquatic insects) in the area would be killed. Given the

limited area affected, no aquatic species' population is expected to be permanently affected. The cofferdam, once constructed, would mitigate the most severe siltation effects from construction of the water diversion structure.

Operation Effects. The Buckman Project diversion structure and water intake screens are designed, using standard engineering fish screening criteria, to avoid entrainment of fish eggs and juveniles. The design flow is 32 cfs with an approach velocity of 0.33 feet per second (typical California criteria for small fish) and a sweeping velocity (velocity parallel to screens) and transport time past the screens of 18 seconds. Fish screens would have a mesh size of 2mm. The actual impacts to fish species from operations are unknown, however, the following impact assessment is based on the professional opinion of the Buckman Project aquatic biologists. Even with the design mitigations, entrainment of juvenile fish will occur. These impacts to the aquatic food web would be minimal and it is extremely unlikely that there would be any measurable change in the biotic organization (change in fish population ratios) of the river. None of the species captured in this stretch of the Rio Grande have drifting eggs. Thus, the effect of a diversion structure on these species by entrainment of eggs is likely to be negligible. As for larval fishes, Rio Grande chub, white suckers and longnose dace have drifting larvae. However, the white sucker and longnose dace are very abundant in this reach and given that larval fishes usually experience very high natural mortality rates, a slight increase, if any, in mortality from water diversion structure entrainment would likely be immeasurable. The Rio Grande chub has larvae that drift for a short period, thus a diversion structure could entrain drifting larvae of this species. Given the project design and potentially low densities of Rio Grande chub in the area, and the fact that it has not been collected during recent surveys, it is not likely that the proposed project would have a discernable impact on the species' population. BLM has implemented a "Rio Grande Aquatic Species Monitoring Program." The data gathered from this program would be used in the future to assess changing conditions as a result of proposed or altered water release regimes and river water diversion activities.

There could be limited, localized effects from sediment returned to the river. However, the Rio Grande normally carries a very high sediment load and the return of a small fraction of the sediment contained in the diverted water would likely have a very small impact on downstream fish or invertebrate communities. The very localized effects to aquatic habitat would have no measurable impact to fish or macroinvertebrate communities in the immediate project area. Most of the sediments would be mobilized and moved out of the project area during high flows that occur during spring runoff, storm water runoff, and release of San Juan-Chama waters. Further, the river immediately downstream of the project area rapidly shifts to a sand dominated system and the species located in the project area are adapted to these conditions. Therefore, it is extremely unlikely that a highly localized and minimal (less than 1 percent under most operating conditions) increase in sediment concentrations in the river would cause a shift in the downstream fish assemblage or habitat conditions. The downstream fish community is already dominated by nonnative habitat generalists (common carp, channel catfish, and white suckers) that are well adapted to naturally occurring sand bed habitats that exist downstream of the project area. Implementation of Buckman Road improvements may have very minor but beneficial effects. Better storm water distribution and decreased erosion from Buckman Road could result in decreased sediment loads reaching the Rio Grande from localized storm events.

Water diversion quantities would be quite small compared to normal flow rates and the water diversion would be inoperable in extremely low flow conditions (150 cfs or less). Therefore, adverse effects to the aquatic communities in the Rio Grande reach from the Buckman diversion

site to Cochiti Dam would be minimal and not imperil either aquatic species populations or change the composition of the aquatic community. Diversion of 1,350 ac-ft/yr of native water may affect the Rio Grande silvery minnow downstream of Cochiti Dam. The likely effects to the silvery minnow are addressed in the "Special Status Species" section that follows.

Direct and Indirect Effects of the Sediment Facility Alternatives

The construction and operational effects are similar to the Proposed Action with the following exceptions.

Construction and Operation Effects. Under Alternative SF2 there would be no return of sediment to the Rio Grande. The potential effects identified for sediment return consequences under the Proposed Action would not occur.

Direct and Indirect Effects of the Pipeline Route Alternatives

There is no difference in effects to aquatic species or communities from the Proposed Action compared to the pipeline route alternatives.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. Alternative AGP1 effects would be similar to the Proposed Action for the power upgrade.

Cumulative Effects

Water diversion projects, especially those proposed by the City of Espanola and City of Albuquerque, are additive with the Buckman Project. Overall, due to the quantity of San Juan-Chama diversion water that would be released, the reach from storage at Heron Reservoir to the City of Albuquerque's proposed Paseo del Norte diversion site would receive higher consistent year-round flow. Resource management agencies do not have trend, aquatic populations, or habitat data in which to quantify or assess the potential cumulative impacts resulting from municipality diversions of San Juan-Chama waters. The BOR, USACE, and New Mexico Interstate Stream Commission are currently preparing an Upper Rio Grande Basin Water Operations Review and EIS. This EIS may recommend or conduct studies that will obtain the necessary data to monitor impacts on aquatic species from future water operations. However, because effects from the proposed Buckman Water Diversion Project to aquatic species are not expected to be measurable, no discernable cumulative impacts are forecast (as discussed in the following section, "Special Status Species").

Special Status Species

Special status species are defined as those plants and animals protected under the Federal Endangered Species Act, New Mexico State endangered and threatened species protected under the New Mexico Conservation Act and lists maintained by the BLM and FS. Section 7(c) of the Endangered Species Act requires Federal agencies to obtain information from the FWS regarding any species—listed or proposed for listing—that could be affected by the proposed project. A complete literature search was used to construct a list of special interest plant and animal species known to occur in Santa Fe County. Species status was based upon lists maintained by the FWS, BLM, FS, New Mexico Department of Game and Fish, New Mexico Rare Plant Technical

Council, and the New Mexico Natural Heritage Program. Specific habitat requirements for each of the target species presented by these State and Federal agencies were used to construct a working list of species that might occur within the general project vicinity. Additionally, project biologists participated in discussions with the FWS, conducted field surveys, and collected habitat and taxonomic information for each listed species from a variety of sources.

Species afforded consideration under the Migratory Bird Treaty Act of 1918 and Santa Fe National Forest Plan Management Indicator Species are also addressed. Mitigation or considerations are provided for these species as well as the special status species found in Table 13.

The project area was surveyed, including fish sampling, by qualified biologists between July and August 2002 to determine the habitat suitability of the project area for special status species. The presence or the potential for occurrence based on habitat requirements for special status species or its obligate habitat was noted during these surveys. A general assessment of the area was made based on vegetation health, composition, stature, and consideration of disturbance activities, such as grazing and off-highway vehicle use. Potential nesting or burrowing sites, such as sandy hillsides, rock outcroppings, or clusters of trees or shrubs, were examined for the presence of wildlife.

Effects to the Rio Grande silvery minnow are presented separately due to the public and regulatory interest in the effects to this Federally-listed endangered species. The other special status species are described and effects assessed following the silvery minnow presentation.

Table 13. Santa Fe County special status plants and animals that could occur within the project area.

Common Name	Status				Species Information
(*Scientific Name*)	FWS	FS	BLM	NM	Habitat Requirements
PLANTS					
Santa Fe cholla (*Opuntia viridiflora*)	SC	–	S	E	Currently, this species is known only from Fort Marcy Park in Santa Fe and in the Pojoaque area. General habitat consists of gravelly rolling hills in piñon-juniper woodlands. Specimens were not found during field surveys.
Santa Fe milkvetch (*Astragalus feensis*)	–	–	–	SC	Habitat requirements are gravelly hillsides in piñon-juniper grasslands. There may be small pockets of suitable habitat for this species within the proposed project area. This species was not found during field surveys.
FISH					
Flathead chub (*Platygobio gracilis*)	–	–	S	–	Habitat requirements consist of turbid, alkaline waters with shifting substrates. This species is common near the proposed diversion site and was the second most abundant species captured during the sampling effort.

Common Name	Status				Species Information
(*Scientific Name*)	FWS	FS	BLM	NM	Habitat Requirements
Rio Grande chub (*Gila pandora*)	–	–	–	S	Habitat requirements consist of impoundments of small to moderate streams. Although it was not collected in recent surveys of the Rio Grande near the proposed diversion site, it is possible that the chub does occur in this stretch of river at low densities or intermittently.
Rio Grande silvery minnow (*Hybognathus amarus*)	E	(S)	–	(E)	The Rio Grande silvery minnow is a FWS endangered species that requires silt and sand substrates with slow backwaters or eddies. The species appears to be extirpated from the reach containing the diversion site. It is potentially present from below Cochiti Dam to the headwaters of Elephant Butte Reservoir. (See the section on "Rio Grande Silvery Minnow.")
REPTILES AND AMPHIBIANS					
Desert kingsnake (*Lampropeltis getula splendida*)	–	S	–	–	The desert kingsnake prefers riparian and grassland habitats in New Mexico but is also found in piñon-juniper and low desert areas. This snake uses rock outcroppings or mammal burrows to escape midday heat. It is likely to occur in the project area.
Northern leopard frog (*Rana pipiens*)	–	S	–	–	This species is found along the entire length of the Rio Grande. It is mainly found in streams and rivers, but also occurs in marshes, ponds, and irrigation ditches. It was not found during project surveys.
BIRDS					
Bald eagle (*Haliaetus leucocephalus*)	T	S	–	T	The bald eagle is a winter migrant along the Rio Grande. Most of the preferred roost sites are in snags and cliffs along the river in the section between Bandelier National Monument and the Cochiti Reservoir delta.
Gray vireo (Vireo vicinior)	–	S	–	T	In New Mexico, gray vireos are found sporadically throughout the State where it is considered uncommon. Gray vireos inhabit juniper woodlands in arid foothills and on mesas. Juniper woodlands are abundant within and contiguous with the project site. It was not found during project specific surveys. However, a biological survey for PNM Project Power study did record the species in the general vicinity.
Loggerhead shrike (*Lanius ludovicianus*)	–	–	S	–	This bird utilizes a variety of habitats including desert scrub and open grasslands, though it prefers to nest in trees of medium to tall height. Loggerhead shrikes are fairly common year-round residents throughout Santa Fe County. Individuals of this species were seen in the general vicinity of the proposed project route. The entire proposed project area contains suitable nesting habitat for this species.
Mountain plover (*Charadrius montanus*)	–	S	–	S	Mountain plovers are considered to be strongly associated with sites of heaviest grazing pressure to the point of excessive surface disturbance. Their nesting sites are dominated by short vegetation and bare ground, often with manure piles or rocks nearby. Suitable habitat is present in the proposed project area.

Common Name	Status				Species Information
(*Scientific Name*)	FWS	FS	BLM	NM	Habitat Requirements
Western burrowing owl (*Athene cunicularia hypugaea*)	SC	–	S	–	This species' habitat requirements are open grasslands, prairies, and desert scrub. It occurs as a summer resident and is fairly common in Santa Fe County. This owl typically nests in abandoned mammal burrows. This owl is frequently found in close proximity to human activities and is often associated with prairie dog towns, one of which occurs immediately adjacent to the proposed project ROW.
Zone-tailed hawk (*Buteo albonotatus*)	–	S	–	–	The zone-tailed hawk is found in Montane woodlands and mesas, often near waterways, and is present in White Rock Canyon and documented in Bandelier National Monument.
					MAMMALS
Gunnison's prairie dog (*Cynomys gunnisoni*)	–	–	–	S	Gunnison's prairie dog habitat consists of open grasslands from low valleys to montane meadows. A small colony of prairie dogs is located adjacent to the proposed project route along South Meadow Road at the southwest terminus of the pipeline. Chapter 14 Section 14-8.12 of the City of Santa Fe's Code contains the Gunnison's prairie dog relocation regulations to protect the diminishing populations of Gunnison's prairie dogs by ensuring their safe and humane relocation prior to the development of property within the City of Santa Fe to appropriate and protected habitat areas as designated by the City.
Red fox (*Vulpes vulpes*)	–	–	–	S	The red fox is known in the State primarily from the San Juan and Sangre de Cristo Mountains. Where present, it is commonly found in relatively open areas or adjacent to urbanized or agricultural lands. No foxes or dens were detected during the field survey. There is a small chance that red fox may hunt or den within the proposed project area.
Ringtail (*Bassariscus astutus*)	–	S	–	S	This species, though seldom seen, is fairly common throughout most of New Mexico. These nocturnal, raccoon-like carnivores inhabit a variety of rocky, broken terrains at low- to mid-elevations. There may be limited suitable habitat for this species within the pipeline corridor.
Western spotted skunk (*Spilogale gracilis*)	–	–	–	S	This species has been recorded in Santa Fe County and can occur in many habitats including lower montane, mixed shrub, sagebrush, piñon-juniper, wetland, and riparian areas. They generally use rocky areas for denning sites. Potential habitat may exist in the proposed project area, but occurrence of this species is unlikely.

Status designations are: Endangered (E), Threatened (T), Sensitive (S), and Species of Concern (SC). Table designations in parentheses are listed by the agency for New Mexico, but not specifically for Santa Fe County.

(Source: Much of the information contained in this table was obtained from the New Mexico Game and Fish BISON-M, Biota Information System of New Mexico Web site at http*://nmnhp.unm.edu/bisonm/bisonquery.php*.)

Rio Grande Silvery Minnow

The silvery minnow is the only surviving small, native pelagic spawning minnow in the middle Rio Grande (FWS 2003a). It is herbivorous, feeding primarily on algae, and travels in schools. The silvery minnow tolerates a wide range of habitats but generally prefers low velocity areas over silt or sand substrate that are associated with shallow braided runs, backwaters or pools. They spawn in about a 1-month period in late spring to early summer (May to June) in response to spring runoff. Spawning occurs in the water column and its eggs, approximately 3,000 to 6,000 per adult female, subsequently drift passively downstream with the current (FWS 2003b).

Reduction in the range of the Rio Grande silvery minnow to 5 to 10 percent of historical distribution, and threats to its continued existence in the Middle Rio Grande (outflow of Cochiti Reservoir to the headwaters of Elephant Butte Reservoir, a stretch of approximately 175 river miles) were central to this species being listed as Federally endangered. The silvery minnow was Federally-listed as endangered for the following reasons:

- Regulation of stream waters, which has led to severe flow reductions, often to the point of dewatering extended lengths of stream channel.
- Alteration of the natural hydrograph, which effects the species by disrupting the environmental cues the fish receives for a variety of life functions, including spawning.
- Streamflow reductions and other alterations of the natural hydrograph throughout the year, which can severely impact habitat availability and quality, including the temporal availability of habitats.
- Actions such as channelization, bank stabilization, levee construction, and dredging, resulting in both direct and indirect effects to the silvery minnow and its habitat by severely disrupting natural fluvial processes throughout the flood plain.
- Construction of diversion dams that fragment the habitat and prevent upstream migration.
- Introduction of nonnative fishes that directly compete with the silvery minnow.
- Discharge of contaminants into the stream system from industrial, municipal, and agricultural sources which may also impact the species.

These reasons for listing continue to threaten the species throughout its currently occupied range in the Middle Rio Grande (FWS 2003b).

Affected Environment

The silvery minnow was historically one of the most widespread and abundant fishes in New Mexico. In the Rio Grande, it ranged from the confluence of the Rio Chama near Española to the Gulf of Mexico, and in the Pecos River from near Santa Rosa to its confluence with the Rio Grande. Recent investigations document the presence of the silvery minnow in less than 5 percent of its historic range. It is restricted to the reach from Cochiti Dam to the headwaters of Elephant Butte. No documentation of the silvery minnow above Cochiti Dam has occurred since prior to the construction and operation of Cochiti Dam in the mid-1970s (BOR/City of Albuquerque 2002).

On April 5, 2001, the FWS published in the “Federal Register” (66 FR 18107) a Notice of Intent to prepare an EIS for designation of critical habitat for the Rio Grande silvery minnow. In February 2003, the FWS issued the final rule and designation of critical habitat for the silvery minnow. The final rule that became effective March 21, 2003, states that the reach upstream of

Cochiti Reservoir to the confluence of the Rio Chama and Rio Grande is not designated as critical habitat. The FWS concluded that the habitat for the silvery minnow within this river reach is generally degraded and unsuitable, and is not essential to the conservation of the silvery minnow (FWS 2003a). The EIS addressed the FWS proposal to designate the currently occupied reaches of the Rio Grande in New Mexico as critical habitat for the silvery minnow. Effects of the designation of critical habitat include an increased scope of consultations, which would be expanded to include effects of actions on critical habitat, as well as some changes to the actions to avoid adverse modification. It is likely that efforts would be made to increase the flow in the Rio Grande in areas that now experience drying events. This is a controversial effort to minimize drying events, combined with river restoration activities for the minnow, which if successful, could favorably affect riverine and riparian ecosystems. Designating critical habitat does not, in itself, lead to the survival or recovery of the species. Nevertheless, by identifying areas essential to the conservation of the species, and by requiring consultation, designation provides an opportunity for Federal agencies, the public, and other organizations to collaborate for the protection of needed habitat (FWS 2002).

In January 2000, several parties in the Middle Rio Grande signed a memorandum of understanding to develop a long-term strategy that would assist in the conservation and recovery of the Rio Grande silvery minnow and the southwestern willow flycatcher, while protecting existing and future water uses. Participation has grown significantly since January 2000 to include additional state agencies, water interests, and Indian Tribes and Pueblos. Key participants include the FWS, BOR, USACE, BIA, City of Albuquerque, MRGCD, New Mexico ISC, New Mexico Department of Game and Fish, and the Alliance for the Rio Grande Heritage. The strategy being developed by this group has been termed the Middle Rio Grande Collaborative Program. The Proposed Action area for the program extends from the headwaters of the Rio Chama watershed and the Rio Grande, including all tributaries, from the Colorado/New Mexico state line downstream to the headwaters of Elephant Butte Reservoir (FWS 2002).

In late 2000, the Rio Grande silvery minnow naturalized rearing and breeding project was initiated in response to a lawsuit. It includes the design, construction and operation of a rearing and breeding facility that would ensure the short-term survival and long-term recovery of the silvery minnow. The short-term goal for the facility is to supplement existing captive populations in aquaria. The facility's long-term operations are intended to maintain breeding populations to supplement wild populations; provide fish for reintroduction into portions of their historic range and habitat enhanced range; act as an emergency refuge in times of drought; and provide research opportunities to learn more about the silvery minnow and its habitat preferences (OSE/ISC 2001). The facility is operational. Silvery minnows are currently housed at five facilities in New Mexico: the Dexter National Fish Hatchery; New Mexico State University Coop Unit; Rock Lake State Fish Hatchery; the FWS Fishery Resources Office; and the City of Albuquerque's propagation facilities. These facilities are actively propagating and rearing silvery minnows or are available for propagation. In 2000, the total combined capacity of these facilities was approximately 175,000 silvery minnow juveniles and adults. New facilities are being constructed at the City, the Dexter National Fish Hatchery, and at Fishery Resources Office that would increase the total capacity of all facilities to approximately 500,000 juveniles and adults. Silvery minnows are also held in South Dakota at the USGS, Biological Resources Division Lab, but there is no active spawning program at this facility (FWS 2003b).

Environmental Consequences

Environmental consequences from the Buckman Project upon the silvery minnow would be the result of the diversion of native Rio Grande waters and not the diversion of San Juan-Chama water. San Juan-Chama water is not native to the Rio Grande and was not originally intended to ensure the survival of the silvery minnow. However, it has been purchased in the past to provide water during low flow conditions in the Rio Grande. Potential effects to other special status species are identified in Table 14.

No Action Alternative

Under this alternative, there would be no construction and operation of the Buckman Project, thus there would be no diversion of either San Juan-Chama or native Rio Grande waters and there would be no effects to the Rio Grande silvery minnow.

Direct and Indirect Effects of the Proposed Action

Construction Effects. There would be no construction-related effects to the silvery minnow as it does not occur upstream of Cochiti Dam.

Operation Effects. Once the diversion structure is operational, diversion of native Rio Grande water would be a direct and cumulative affect to the Rio Grande silvery minnow. Because downstream effects are best described in terms of the cumulative effects of other water projects, the effects analysis is presented in the cumulative effects section. It should be noted that the Buckman Project's proposed diversion of San Juan-Chama waters would be offset by San Juan-Chama water releases such that there would be no net effect on flow downstream of the Buckman water diversion site. It would be the diversion and consumption of native waters made possible by implementation of the Buckman Project that has the potential to effect the silvery minnow.

Direct and Indirect Effects of the Sediment Facility Alternatives

There would be no direct or indirect construction or operation effects to the Rio Grande silvery minnow under any of the sediment facility alternatives.

Direct and Indirect Effects of the Pipeline Route Alternatives

There would be no direct or indirect construction or operation effects to the Rio Grande silvery minnow under any of the pipeline route alternatives.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. Alternative AGP1 effects would be similar to the Proposed Action for the power upgrade.

Table 14. Potential effects to Santa Fe County special status plants and animals that could occur within the project area due to the Proposed Action.

Common Name (*Scientific Name*)	Project Effect	Construction and Operation Considerations
	PLANTS	
Santa Fe cholla (*Opuntia viridiflora*)	No effect, as this species was not found in the project construction boundaries.	None
Santa Fe milkvetch (*Astragalus feensis*)	No effect, as this species was not found in the project construction boundaries.	None
	FISH	
Flathead chub (*Platygobio gracilis*)	Given the range of the flathead chub in the project area and its high frequency of capture, it is unlikely that the Proposed Action would have a measurable affect on the species overall population.	None
Rio Grande chub (*Gila pandora*)	The Rio Grande chub has larvae that drift for a short period, thus a diversion structure could entrain drifting larvae of this species. Given the project design and potentially low densities of Rio Grande chub in the area, and the fact that it has not been collected during recent surveys, it is not likely that the proposed project would have a discernable impact on the population.	None
Rio Grande silvery minnow (*Hybognathus amarus*)	The species appears to be extirpated from the reach containing the diversion site. However, the diversion of approximately 1,350 ac-ft/yr of native Rio Grande water could have downstream effects to this species. (See the section, "Rio Grande Silvery Minnow")	Construction: There would be no construction related effects to this species. Operation: See the effects discussion previously and presented in the section, "Rio Grande Silvery Minnow."
	REPTILES AND AMPHIBIANS	
Desert kingsnake (*Lampropeltis getula splendida*)	This species is likely to occur in the project area and would be difficult to detect in habitat potentially affected by construction. Should construction result in the mortality of an individual(s) the long-term effect on the species population would not be measurable.	None
Northern leopard frog (*Rana pipiens*)	This species may utilize the immediate area of the water diversion site. No frogs were noted during the field survey. However, if present, approximately 40 feet of shoreline foraging and sunning habitat for this species would be temporarily lost during construction activities. Following construction, this species would likely reestablish itself in the area.	None

Common Name (*Scientific Name*)	Project Effect	Construction and Operation Considerations
	BIRDS	
Bald eagle (*Haliaetus leucocephalus*)	Effects, if any, to this species would be limited to temporary dispersals during construction activities and/or avoidance of the Rio Grande where construction activities are taking place. No prime eagle roosting sites would be removed or otherwise affected by the proposed project. Construction activities at the Rio Grande may affect, but are not likely to adversely affect, bald eagle individuals or populations.	Construction: If bald eagles are roosting in the immediate area prior to daily construction activities, construction would not commence until the eagles have left the area. Operation: There are no operational effects.
Gray Vireo (Vireo vicinior)	Much of the project area contains suitable nesting habitat for this species. Individuals of this species were not seen during project field surveys. However, gray vireo's were seen in the general vicinity for another project.	Construction: Should it be necessary to remove or otherwise disturb potential nesting trees during the April 1 to August 15 nesting period, a survey, conducted by a qualified biologist, for gray vireo's would be conducted. Operations: There are no operational effects.
Loggerhead shrike (*Lanius ludovicianus*)	The entire proposed project area contains suitable nesting habitat for this species. Individuals of this species were seen in the general vicinity of the proposed project route during the field survey. However, none were seen in the immediate ROW and no characteristically skewered prey items were found on the thorny vegetation or barbed wire fences of the proposed project area.	Construction: Should it be necessary to remove or otherwise disturb potential nesting trees during the April 1 to August 15 nesting period, a survey, conducted by a qualified biologist, for loggerhead shrikes would be conducted. Operations: There are no operational effects
Mountain plover (*Charadrius montanus*)	Mountain plovers were not detected during field surveys even though suitable habitat was present. It is not considered likely that this ground-nesting bird nests or forages in the vicinity. The Biotic Information System for New Mexico lists their occurrence in Santa Fe County as irregular and rare.	Construction: Should construction occur during the April through June nesting season, a pre-construction survey, performed by a qualified biologist, for mountain plovers would be conducted. If a nest site is discovered, construction would be delayed in the affected area until the chicks are fledged. Should foraging individuals be present, construction would be delayed until they vacate the area. Operations: There are no operational effects.

Common Name (*Scientific Name*)	Project Effect	Construction and Operation Considerations
Western burrowing owl (*Athene cunicularia hypugaea*)	Burrowing owls were not detected during field surveys, though there were a few suitable burrows and other potential nesting sites encountered. Typical presence indicators such as molted feathers, pellets, eggshell fragments, prey remains, and excrement were likewise not encountered. Currently, it is not likely that burrowing owls utilize the immediate proposed project area. If present during construction, they would be expected to vacate the area, unless nesting. Burrowing owls, if present in the construction area, may abandon the area.	Construction: A preconstruction survey by a qualified biologist would be conducted. Should burrowing owls be present within the construction site, they would be allowed to move off on their own accord. Should they not do so, the New Mexico Department of Game and Fish would be consulted regarding relocation strategy and practices. With relocation, effects to the population would be minor and short-term. Operations: There are no operational effects.
Zone-tailed hawk (*Buteo albonotatus*)	While potentially present in the White Rock Canyon Area and documented in Bandelier National Monument, this species would not likely be affected by the proposed project.	Construction: There are no construction effects. Operations: There are no operational effects.
	MAMMALS	
Gunnison's prairie dog (*Cynomys gunnisoni*)	The South Meadow Road prairie dog colony has been cleared out of the roadway ROW and proposed pipeline route by a previous, unrelated construction project. As of this writing, this colony had not re-established itself within the ROW.	Construction: The South Meadow Road prairie dog colony site would be surveyed by a qualified biologist prior to construction activities. If prairie dogs are found within the project corridor, then the requirements found in Chapter 14, Section 14-8.12 of the City of Santa Fe's Code regarding Gunnison's prairie dog relocation would be followed. Relocation of prairie dogs within the construction corridor would avoid adverse effects to this prairie dog population. Operations: There are no operational effects.
Red fox (*Vulpes vulpes*)	If present, the red fox would avoid the area during construction activities. Effects to this species would be minor and short-term.	None

Common Name (*Scientific Name*)	Project Effect	Construction and Operation Considerations
Ringtail (*Bassariscus astutus*)	This secretive species may utilize denning and foraging sites within the proposed project area. If present, the ringtail may temporarily avoid the proposed project area during construction activities. However, it is more likely that this nocturnal species would remain dormant in its shelter sites during daytime construction activities. Should construction result in the mortality of an individual, the effects to the local population would be minor and short-term.	None
Western spotted skunk (*Spilogale gracilis*)	The proposed project area is likely outside the current distribution of this species. If present, affects to this species would likely be limited to temporary dispersals during construction activities.	None

Cumulative Effects

The area of likely effect to the Rio Grande silvery minnow would be from the City of Albuquerque's proposed Paseo del Norte Diversion to Elephant Butte Reservoir. The cumulative effects of the Buckman Direct Diversion have been analyzed, taking into account projects that are likely to affect the silvery minnow within the planning horizon for this project (2010). The potential increase in native water diversions from the City of Albuquerque would be additive with the Buckman Project as both projects would affect native Rio Grande water flow in silvery minnow habitat.

While most of the Buckman Project's diverted water would consist of existing San Juan-Chama contracted water, upwards of 1,925 ac-ft/yr or 22 percent of the 8,730 ac-ft/yr diversion water would be native Rio Grande water. The 1,925 ac-ft/yr of native water would be comprised of the County of Santa Fe's existing right to 71.2 ac-ft/yr of Rio Grande native water and, for the purposes of this analysis, assumes that the County would obtain an additional 1,254 ac-ft/yr of Rio Grande native water rights to meet their projected water demand of 1,700 ac-ft/yr by the year 2010. Leasing or purchasing of water rights would be subject to permits and approvals from the Office of the State Engineer and are outside the scope of this document. Las Campanas would exercise their approximate 600 ac-ft/yr Rio Grande native water right to augment their 1,200 ac-ft/yr of San Juan-Chama water in order to meet their year 2010 demand for 1,800 ac-ft/yr.

Table 15. Amount of native water removed.

River Flow (Otowi Gage)		Total Diversion Flow		Native Water Diversion (22% Total = Native)		Native Water Percent of Diversion	
Monthly Average (cfs)		Max (cfs)	Ave. (cfs)	Max (cfs)	Ave (cfs)	Max	Ave.
January	788	11.3	6.8	2.49	1.50	32%	19%
February	894	12.7	7.7	2.80	1.70	31%	19%
March	1,293	14.1	8.5	3.11	1.87	24%	14%
April	2,077	18.2	11.0	4.01	2.43	19%	12%
May	3,397	23.8	14.4	5.25	3.18	15%	9%
June	2,994	28.2	15.8	6.22	3.48	21%	12%
July	1,433	26.1	15.8	5.76	3.48	40%	24%
August	1,004	23.8	14.4	5.25	3.18	52%	32%
September	850	22.6	13.7	4.98	3.02	59%	36%
October	779	19.6	11.9	4.32	2.62	55%	34%
November	1,012	14.1	6.8	3.11	1.50	31%	15%
December	916	11.3	7.7	2.49	1.70	27%	19%

For purposes of analysis, Table 15 illustrates that the amount of native water that could be removed through the Buckman Direct Diversion is small when compared with river flow. During high flow months (April, May, June), maximum diversions would be less than 20 percent. In September, when demand for water is high and river flows are low, as much as nearly 60 percent of the flow would be taken. On average during a given month, the percentages would be less (9 percent up to 36 percent). This means that for any given month, the reduction in the flow of native water attributed to the Buckman Direct Diversion would be slight.

Although the amount of flow reduction is small, at certain times of the year and generally the hot summer months when Rio Grande native water flow is reduced and water demand is high, any reduction of native water flow is important to the silvery minnow. During these low flow periods, occupied reaches of the river dry up and further reduction in water flow would have a cumulative impact on the available habitat for the silvery minnow. Drying stretches of river forces the minnow into pools where they are more vulnerable to predation, disease, and rising water temperature. Longer duration lack of flow results in pool evaporation and mortality of the fish trapped in them.

Overall, when the City of Albuquerque operates their proposed Paseo del Norte Diversion, an increase in flow of approximately 61 cfs, relative to current conditions, from the outlet works at Heron Reservoir to the Paseo del Norte diversion point would occur. Thus, even with the proposed Buckman Project the stretch of river from Heron Reservoir to Paseo del Norte would receive higher consistent year-round flow. However, when the City of Albuquerque diverts water at their Paseo del Norte diversion site, the Rio Grande stretch from Paseo del Norte to Elephant Butte could experience a decrease of approximately 1,925 ac-ft/yr of native water flow as a result

of Santa Fe County and Las Campanas native water diversion of the proposed Buckman Project. It is the loss of native water in the Paseo del Norte to Elephant Butte reach that would most effect the silvery minnow. Thus, the cumulative effects of the Buckman Project and Albuquerque's proposed diversion could reduce native Rio Grande water flow in occupied silvery minnow reaches subsequently increasing the duration and extent of river drying by a small, but measurable amount. However, as stated in the draft EIS for the City of Albuquerque Drinking Water Project, the City of Albuquerque would begin to curtail diversion of its San Juan-Chama water from the Rio Grande when the native flows above the diversion point reach 135 cfs or less. As the flows continue to decline, the City of Albuquerque would reduce diversions until the river reaches 70 cfs of native water at the diversion point. At that point, the City would suspend surface water diversion until flows recover, and temporally would rely solely on ground water for drinking water. This suspension of water diversion may have implications for stabilizing, downstream of the proposed Paseo del Norte diversion, Rio Grande native water flows even with upstream native Rio Grande water diversions.

The applicants, Santa Fe County and Las Campanas, would take advantage of native flows during nonpeak time when the Rio Grande has a higher base flow and become more reliant on San Juan-Chama water during native water low flow conditions. The Buckman water diversion structure would not be operable at full capacity (diversion of 28 cfs) at river flow rates of 200 cfs or below and would be inoperable during very low river flow circumstances of 150 cfs or less. In nondrought years, these Buckman project-specific measures coupled with the development and implementation of regional conservation measures, including operation of the silvery minnow refugium, would avoid effects from the Buckman diversion of native water on the silvery minnow.

In drought years and as regional water requirements increase, the Buckman diversion could reduce native water availability to the silvery minnow by 1,925 ac-ft/yr and contribute to the drying of the Rio Grande below the Paseo del Norte diversion site. However, the Buckman Project's commitment to use native flows during nonpeak times and the design of the Buckman water diversion structure to not allow water diversion at flows 150 cfs or less coupled with the regional mitigation measures would serve to avoid an adverse effect to the silvery minnow population.

Special Status Plants and Animals In the Project Area

Affected Environment

There are 7 plant and 51 wildlife special status species that are known to occur, or may occur, in Santa Fe County. However, after conducting further literature searches, field surveys, and habitat assessments, this list was reduced to 2 plant species and 15 wildlife species that could potentially occur in the proposed project construction areas and ROW (see Table 13). The remaining species were determined not likely to occur in the project area based on the lack of suitable habitat and no record of their occurrence in the project area; or in the case of plant species, were not encountered during field surveys. One Federally listed threatened species, bald eagle (*Haliaetus leucocephalus*), is known to be a winter migrant in the area. Additionally, due to the potential diversion and use of native water, the Federally listed endangered Rio Grande silvery minnow (*Hybognathus amarus*) is addressed in the "Cumulative Effects" section. Also addressed in this

section are FS Management Indicator Species that occur in the project area and considerations for those species protected under the Migratory Bird Treaty Act of 1918.

Management Indicator Species. The Santa Fe National Forest Plan identifies seven species as Management Indicator Species. These species were selected to represent specific habitats and the species that use those habitats. These species are: Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*), piñon jay (*Gymnorhinus cyanocephalus*), wild turkey (*Meleagris gallopavo*), hairy woodpecker (*Picoides villosus*), Mexican spotted owl (*Strix occidentalis lucida*), mourning dove (*Zenaida macroura*), elk (*Cervus elaphus nelsoni*), and Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*). Within the proposed project area, habitat exists only for the piñon jay and mourning dove.

The piñon jay is primarily a species of dense piñon-juniper and pine woodlands; this species was identified adjacent to the project area. They could occupy hillside habitat within the proposed project area that have larger aggregations of trees. Piñon jays are highly colonial and depend heavily on the presence of piñon nuts, not only for food, but also as an environmental cue to initiate breeding. The Santa Fe National Forest contains over 450,000 acres of habitat. The piñon jay population is ranked as common for the Santa Fe National Forest (FS 2003). Surveys conducted by the U.S. Geological Survey between 1968 and 1998 indicate a shale or downward trend for piñon jay within the State of New Mexico. The trend for the Santa Fe National Forest is ranked as stable to downward based on the State trend and the breeding survey routes located near the Santa Fe National Forest (FS 2003). Piñon jays would use the pipeline area for foraging and hunting.

Mourning doves inhabit a variety of areas including scrublands, grasslands, open woodlands, and residential areas. Throughout the Santa Fe National Forest, mourning dove habit is considered stable to increasing and the population is ranked as common (FS 2003). Though not observed during site surveys, suitable nesting habitat for this species is found throughout the proposed project area.

The Migratory Bird Treaty Act of 1918 was implemented to protect the international export and import of avian species. The act protects nesting migratory birds from harassment, harvest, and harm. There are around 40 species protected under the act that may utilize habitat in the project area. Sixteen species are potentially year-round residents and 24 species may be in the area only during breeding season.

Environmental Consequences

A project-specific search of the New Mexico Natural Heritage Program database did not reveal any records of currently listed special status species in the proposed project area. Sixteen special status species were identified that have potential occurrence or habitat within the construction areas. Three species (Flathead chub, Loggerhead shrike [*Lanius ludovicianus*], and Gunnison's prairie dog) were observed in close proximity to the project construction boundaries. One species, Rio Grande silvery minnow, while not occurring in the area, could experience an effect from the proposed diversion of native Rio Grande water and has been previously addressed. Project construction and operations are not expected to adversely affect any population of a special status species.

No Action Alternative

Under the No Action Alternative, there would be no disturbance of or change to special status species or their habitats.

Direct and Indirect Effects of the Proposed Action

Construction and Operations. Table 14 addresses the effects to special status species.

The piñon jay and mourning dove, Management Indicator Species, are in the construction project area. Both species may experience temporary disruption and displacement from construction activities. Removal of piñon pines would represent a minor decrease in food supply for the piñon jay. However, many of the piñon pines that would be removed in the project area are dead or showing signs of die-off as a result of the bark beetle infestation. There would be permanent and minor decrease in potential habitat once all water diversion facilities are built and Buckman Road is improved. However, due to the good health of the piñon jay and mourning dove populations and available habitat, project effects would be very minor.

The Migratory Bird Treaty Act of 1918 provides for the protection of migratory birds from harassment, harm, or harvest. The primary concern to the integrity of avian communities associated with the proposed project area is the removal or disruption of nesting activities and nest destruction. The FWS Web site contains the following information: "As authorized by the Migratory Bird Treaty Act, the FWS issues permits to qualified applicants for the following types of activities: falconry, raptor propagation, scientific collecting, special purposes (rehabilitation, educational, migratory game bird propagation, and salvage), take of depredating birds, taxidermy, and waterfowl sale and disposal. Migratory bird permit policy is developed by the Division of Migratory Bird Management and the permits themselves are issued by the Regional Bird Permit Offices. The regulations governing migratory bird permits can be found in 50 CFR Part 13 (General Permit Procedures) and 50 CFR Part 21 (Migratory Bird Permits)." Implementation of the pre-construction bird survey by a qualified biologist and/or compliance with the following process would serve to avoid impacts to species covered under the Treaty or be compliant with the Treaty:

> If the contractor is working (a) during the nonnesting season (between August and March) or (b) during the nesting season (which in this area of Santa Fe would include April through July) and a nest is found but is not being used; there is no requirement for a permit.

However, if the work is being done during the nesting season and a nest is found that is being used, the contractor has two options:

- Wait for nesting/fledging to be completed; or
- Apply to the FWS for a permit so take is authorized under the Migratory Bird Treaty Act. The FWS has a 30-day response period, but if it is an emergency, phone calls and faxing paperwork could complete the process within 48 hours.

Direct and Indirect Effects of the Sediment Facility Alternatives

Construction and Operation. Effects from the sediment facility alternatives are expected to be similar to the Proposed Action with the following exception: Alternative SF2 would result in additional improvements to Buckman Road including straightening and widening. Additional loss of habitat adjacent to Buckman Road would occur, and the area would probably experience more

visitation and recreational use resulting in increased disturbance to special status species and their habitat.

Direct and Indirect Effects of the Pipeline Route Alternatives

Construction and Operation. The construction and operation effects are similar under the Proposed Action except that Alternative TWP1 would be constructed and operated in a new ROW corridor and, similarly, Alternative TWP2 would require a short run of new ROW corridor. Construction and operation of new pipeline corridors would result in the minor and short-term removal of vegetation and subsequent forage base reduction for some special status species. Development of new corridors could encourage changes to and increased recreation use in the area and subsequent degradation to vegetation and habitat of special status species.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. Alternative AGP1 effects would be similar to the Proposed Action for the power upgrade.

In compliance with the Endangered Species Act, a biological assessment will be prepared and submitted to the FWS for their review, comment, and concurrence, if appropriate, of effect. Similarly, for FS sensitive species, a biological evaluation will be prepared and submitted for FS review, comment, and concurrence, if appropriate, of effect.

Cumulative Effects

Habitat loss from implementation of the Proposed Action and alternatives could result in the permanent loss of approximately 59 acres. For special status species that utilize the affected area, this would be additive to the continuing habitat loss within lands contiguous with or in close proximity to the Buckman Project area in Santa Fe, Rio Arriba, and Los Alamos Counties, as well as San Ildefonso Pueblo lands. Habitat loss is primarily a result of new road construction (NM 284/85), housing development, and increasing recreation use of public lands. Cumulative effects to the Rio Grande silvery minnow are addressed in the previous section, “Rio Grande Silvery Minnow.”

Cultural Resources

Cultural resources are those aspects of the physical environment that relate to human culture, society, and cultural institutions that hold communities together and link them to their surroundings. Cultural resources include expressions of human culture and history in the physical environment, such as prehistoric and historic sites, buildings, structures, objects, districts, natural features, and biota, which are considered important to a culture, subculture, or community. Cultural resources include aspects of the physical environment that are a part of traditional lifeways and practices, and are associated with community values and institutions.

Cultural Resource Types. Cultural resources include prehistoric and historic archaeological sites and ethnographic resources. Archaeological sites are the tangible remains of past activities that show use or modification by people. Archaeological sites are distinct geographic areas that can include artifacts, features such as hearths, road remnants, or railroad grades, landscape alterations, or architecture. In general, archaeological sites are the locations of purposeful human activity that

have resulted in the deposit of cultural materials beyond the level of a few accidentally lost artifacts. Remains that do not meet this criterion are still archaeological in nature, but are described as isolated occurrences. Prehistoric archaeological sites refer to cultural resources used or modified by people before the establishment of a European presence in the upper Rio Grande Valley in the early 17th century. Historic archaeological sites are those cultural resources used or modified since the arrival of Europeans in the region.

Cultural resources that have a direct association with a living culture may be considered ethnographic resources. These resources can include traditional cultural properties (TCPs), or Native American sacred sites and religious resources. TCPs are places or objects that are important to a particular living community, and this importance is "derived from the role the TCP plays in the community's historically rooted beliefs, customs, and practices" (Parker and King 1990). TCPs are associated with the cultural practices and beliefs that are based in a community's history or important in maintaining the cultural identity of the community. TCPs are used within social, spiritual, political, and economic contexts and, thus, are essential to the preservation and viability of a culture. TCPs are not limited to a certain ethnic group; rather Americans of every ethnic origin have properties to which they ascribe traditional cultural value. In northern New Mexico, Hispanic culture and Native American groups in particular have maintained traditional communities, practices, beliefs, and subsistence patterns.

Cultural Resources and the Law. A number of Federal statutes address the identification of cultural resources and Federal responsibilities with regard to cultural resources. The long history of legal jurisdiction over cultural resources, dating back to 1906 with the passage of the Antiquities Act, demonstrates a continuing concern on the part of Americans for their cultural resources. Foremost among these statutes are the National Historic Preservation Act (NHPA), as amended (16 U.S.C. Section 470), and its revised implementing regulations (36 CFR Part 800). These statutes describe the process for identification and evaluation of cultural resources, assessment of effects of Federal actions on important resources, and consultation to avoid, reduce, or mitigate adverse effects. The NHPA does not require preservation of cultural resources, but does ensure that Federal agency decisions concerning the treatment of these resources result from meaningful consideration of cultural and historic values, and identification of options available to protect the resources.

Tribal Consultation. Various statutes require consultation with Native Americans to identify cultural resources important to tribes and to address tribal concerns about potential effects to these resources. These statutes include the NHPA, American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, Executive Order 13007, and Executive Order 13084. Federal guidelines direct agencies to consult with Native American tribal leaders and others knowledgeable about cultural resources important to them. Consultation addresses Federal actions with the potential to affect locations of traditional concern, religious practices, areas of traditional cultural uses, archaeological sites, and other modern and/or ancestral tribal remains.

Affected Environment

A cultural resource inventory was conducted of the proposed project area in the fall and winter 2002 (Wase et al. 2003). The information presented in this section is based on the findings of this inventory. The inventory included development of a cultural context for the region, research of previously conducted inventories near the project area, survey of the project area, and

consultation with potentially interested Native American tribes. Prior to any ground-disturbing activity, the results of this inventory would be sent to the New Mexico SHPO for consultation, pursuant to Section 106 of the NHPA and 36 CFR Part 800.

Cultural History of the Region

Prehistory. Human occupation of the upper Rio Grande Valley is believed to date from about 12,000 years ago, during the Paleoindian Period (ca. 10,000 – 5500 B.C.). Most archaeologists believe that bands of mobile hunter-gatherers subsisted primarily on large game, but also collected wild plant foods. Paleoindian cultural remains are rare in the Santa Fe area. Other than isolated artifacts, only one site has been recorded. It is located south of the project area near Cañada Ancha.

During the Archaic Period (5500 B.C. – A.D. 600), hunter-gatherers practiced a more diversified subsistence strategy, targeting smaller game, expanding plant gathering activities in response to warmer and drier climatic conditions, and eventually growing maize. Sites can contain evidence of structures, processing pits, storage pits, tool production, and plant processing. Archaeologists have identified Archaic sites near the project area, from valley floors to the foothills. Excavations near the project area have found some Archaic sites deeply buried with little or no surface evidence. Variable site use is apparent in the region, including limited activity sites, temporary base camps, longer duration occupations, and frequent reuse of desirable locations. These sites may indicate that the Late Archaic cultures were the first to occupy the area year-round.

Archaeologists divide the Ceramic Period (A.D. 600 – 1600) into four periods. The Early Developmental Period (A.D. 600 – 900) is marked by the appearance of gray and black-on-white pottery. Sites tend to have one to three pithouses and a sparse scatter of artifacts and tend to be near permanent sources of water. These sites are rare in the upper Rio Grande Valley perhaps because the people here were able to maintain their Archaic way of life longer than populations on the Colorado Plateau to the west. Late Developmental Period (A.D. 900 – 1175) sites are more common, though surveys in the area have found few remains from this period. Sites become larger and pithouses give way to small clusters of surface rooms.

The Coalition Period (A.D. 1175 – 1325) was a time of change, with the number and size of sites increasing, and ceramic decoration changing from the use of mineral paint to carbon-based paint. Work in the area indicates the presence of small villages along rivers, supported by intensive, recurring use of the nearby hills for limited subsistence activities. Coalition Period sites are common in the area and generally contain evidence of surface architecture, thermal features for firing pottery, and extensive artifact concentrations of pottery and stone tool manufacturing debris.

The Classic Period (A.D. 1325 – 1600) saw continued change, especially with the construction of large villages with plazas. Black-on-white pottery is replaced by glaze-painted pottery. The Santa Fe area was heavily occupied during the early part of the Classic Period, but was mostly depopulated after A.D. 1420.

History. After initial explorations, the Spanish established a foothold in northern New Mexico in 1598 with a capital near San Juan Pueblo. The local government parceled much of the area into grants, confirming Pueblo land use or opening lands to Spanish colonists. In 1742, Viceroy Mendoza established two grants near the project area, the Caja del Rio Grant and what became

known as the Ramon Vigil Grant. These grants were located in upland areas, which were valuable for hunting, firewood gathering, and grazing livestock, especially sheep.

The Spanish colony became a part of Mexico in 1821, a territory of the United States in 1846, and one of the states in 1912. The descendants of the original grantee maintained the Caja del Rio Grant until it was sold in 1910 for back taxes. Ramon Vigil obtained his grant from the Sanchez family in 1851. With the coming of the railroad, land was becoming a commodity, and Vigil sold the grant to Winfield R. Smith and George Fletcher. Smith and Fletcher first leased the Vigil Grant to a cattleman whose 3,000-head herd devastated the grazing capacity of the land. In 1898, they leased the timber rights to Harry Buckman, a lumberman from Oregon.

The Denver and Rio Grande Railroad, called the Chili Line and running between Santa Fe and Antonito, Colorado, was completed in 1887. The presence of the railroad stimulated the logging industry and brought about a mining boom to the area. Buckman built a bridge across the Rio Grande next to the Chili Line, built a siding on the east side of the river, and had a road blasted up the cliff west of the river to the top of Pajarito Plateau, establishing timber cutting for profit in the area. Success of the railroad siding and associated lumber camp encouraged the growth of the town of Buckman. A post office was established in the town in 1899. Shipping of lumber and livestock was the economic mainstay of Buckman through the 1920s, and in the early 1900s, the town became a gateway for tourists to Pajarito Plateau. In spite of these interests, changes in access to the plateau gradually caused the depopulation of the town, and by the 1940s, it faded from the landscape.

Buckman was the only residential site near the project area until the recent development of upscale residential areas. The project area contains a number of buried and overhead utilities, and is in a developed water well field. Transitory use of the area continues today, as residents of Santa Fe use the area for recreation. The area is part of grazing allotments of the BLM and FS, and is adjacent to special recreation areas.

Previous Work in the Area

Extensive archaeological research has been conducted near the project area. Within 1 mile of the project area, 52 cultural resource inventories and excavations have been conducted, resulting in the recording of 189 cultural resources. A detailed list of previous researchers and their findings can be found in the cultural resource inventory report prepared for this project (Wase et al. 2003). Seventy-five percent of these recorded resources are prehistoric and 25 percent are historic.

The current project area contains two major soil associations. The older Pojoaque series soils are old alluvium on stable slopes and alluvial fans. When exposed, Pojoaque soils exhibit old prehistoric surfaces. The Bluewing series soils are found in valleys and are derived from recent alluvium of mixed origin. Previous work, together with the current inventory, supports that when Pojoaque soils are exposed at the surface, they are likely to contain prehistoric cultural remains. Surfaces with the Bluewing soils are more recent and are more likely to contain historic cultural materials. However, Bluewing soils can likely cover older surfaces that may contain prehistoric cultural deposits. Thus, there is a possibility that subsurface cultural remains exist below surfaces with Bluewing series soils in the project area.

Cultural Resources Identified in the Project Area

A cultural resource inventory was conducted of the project area, with two exceptions explained below. The inventory included an archaeological field survey that covered the project area for the Proposed Action and the alternatives. The field survey also included buffer zones to allow for realignments of proposed developments to avoid important cultural resources, and to include room for construction activities. The field survey identified 16 archaeological sites and 138 isolated occurrences in the project area and buffer zones. The inventory fully recorded and evaluated all of these resources to determine if they are eligible for listing on the National Register of Historic Places (NRHP). Resources that are eligible or resources where the eligibility remains undetermined are afforded consideration under the NHPA. If a Federal action will affect an eligible resource, then measures must be taken to avoid, reduce, or mitigate the affect. None of the isolated occurrences are eligible for the NRHP. Of the 16 sites, 9 sites are eligible for listing on the NRHP. These 9 sites are presented in Table 16.

Table 16. Eligible archaeological sites identified during field survey of the project area and buffer zones.

Site Number	Description	Age
LA 15222	Buckman townsite	Historic
	Artifact scatter	Prehistoric
LA 98690	Artifact scatter and hearths	Prehistoric
LA 117262	Artifact scatter	Historic
LA 128580	Denver & Rio Grande railroad grade (the Chili Line)	Historic
LA 137068	Artifact scatter and feature	Prehistoric
LA 137070	Artifact scatter	Prehistoric
LA 137072	Artifact scatter	Unknown
LA 137075	Artifact scatter	Unknown
LA 138574	Artifact scatter	Prehistoric
	Artifact scatter and feature	Historic

Note: LA = Laboratory of Anthropology. (Source: Wase et al. 2003)

Two portions of the project area were not inventoried for cultural resources. These are the half-mile of above ground power line near the MRC WTP for the Proposed Action, and the substation and 1 mile above ground power line for Alternative AGP1. These project areas have undergone cultural resource inventory, with no additional sites found. The results will be included with the other evaluation materials to the State Historic Preservation Officer prior to any construction activities taking place at these locations.

Another phase of the cultural resource inventory was consultation with potentially interested tribes. The FS sent consultation letters to the following tribes on August 5, 2002: Pueblo of Jemez, Navajo Nation, Pueblo of Laguna, Pueblo of Acoma, Pueblo of San Juan, Pueblo of San Ildefonso, Pueblo of Santo Domingo, Pueblo of Isleta, Pueblo of Taos, Pueblo of Picuris, Pueblo of Sandia, Pueblo of Tesuque, Pueblo of Nambe, Pueblo of Zia, Pueblo of Pojoaque, and the Jicarilla Apache Nation. As of this printing, none of the tribes has expressed concerns for traditionally important cultural resources in the project area. Consultation efforts will continue with the tribes throughout preparation of the EIS.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, no construction of the Buckman Project would be undertaken. There would be no effects to cultural resources as a result of this alternative.

Direct and Indirect Effects of the Proposed Action

Effects to cultural resources could arise from direct or indirect sources. Potential direct effects can include physical destruction resulting from groundbreaking activities; access to construction areas by large machinery; improvement of existing access and storm water control measures; use of staging areas for storage of equipment and supplies; and future maintenance activities. These physical effects can occur to both known sites and subsurface sites that could be discovered during groundbreaking activities. Another potential direct effect can be the introduction of visual or auditory elements out of character with a resource or disruption of the setting of a resource. These can result from introducing modern buildings and machinery into an otherwise rural or natural setting. Potential indirect effects can include physical harm resulting from changes in erosion patterns that are caused by construction, soil compaction, vegetation removal; increased vandalism or illegal artifact collecting of resources due to the presence of construction and maintenance workers in the area; and an increased probability for inadvertent physical harm to resources both in the short and long term.

Construction Effects. Effects to cultural resources would be mitigated through implementation of the following practices. Archaeological sites would be avoided where possible. Fencing would be erected around sites near the construction area, but not subject to direct effect, to protect them from inadvertent intrusion by construction equipment and personnel. Additionally, a qualified archaeological monitor would be present during all construction excavation and surface modifications. If previously unknown subsurface cultural deposits are discovered, construction activities in the area would halt and the agency would determine appropriate treatment in consultation with the SHPO. Archaeological sites that could not be avoided during construction would have archeological testing or data recovery efforts conducted prior to construction. Subsurface sites discovered during construction activities would also undergo testing or data recovery treatment. Archaeological data recovery would be conducted in compliance with a formal data recovery plan approved by the involved agencies and SHPO. Standard erosion control measures would be in effect during construction activities. All workers conducting construction activities would be educated regarding cultural resources in the project area, appropriate avoidance measures, and associated restrictions per Federal statutes.

Under the Proposed Action, four sites would definitely be directly affected by construction activities: LA 15222 (the townsite of Buckman), LA 138574, LA 98690, and LA 128580 (the Denver and Rio Grande railroad grade). The townsite would be physically affected by the sediment facility, Booster Station 1A, road improvements, underground power line, and various pipelines coming to and going from these facilities. LA 138574 and LA 98690 would be physically affected by the treated water pipeline. The railroad grade would be crossed by pipelines eight times under the Proposed Action. Three sites are located very close to the pipelines and underground power line, and though it seems that they could be avoided on the surface, it is probable that the subsurface deposits of these sites would be affected during construction. These sites include LA 117262, LA 137068, and LA 137075 (pipeline only).

Archaeological testing would be conducted prior to construction to determine if deposits from these three sites extend into the pipeline corridor. Two sites near the pipelines and underground power line, LA 137070 and LA 137072, would be easily avoided during construction. Impacts from construction of the one-half mile above ground power line are unknown at this time because a cultural resource inventory has not yet been done at this location. However, because the power line would be above ground, it is likely that direct physical impacts to resources in this portion of the project area would be avoided by placing the structures away from any identified resources.

Indirect effects to cultural resources are difficult to quantify and could occur to cultural resources both in and outside the project area. Construction of facilities and associated compaction of soils and removal of vegetation would change the erosion patterns, which in turn could physically harm resources. The increase in activities and workers in the area during construction could result in an increase in vandalism or illegal artifact collecting at archaeological sites. Improvements in access to the area could also result in increased vandalism and artifact collecting from members of the public. The increase in construction activities and improvements in public access would also increase the chance for inadvertent physical harm to cultural resources.

Operation Effects. Under the Proposed Action, cultural resource mitigations would include designing the project facilities near Buckman to complement the historic use of the area when viewed from White Rock Overlook Park. In addition, interpretive signage that explains the history of the Buckman area, through text and pictures, would be offered to Los Alamos County for placement at the White Rock Overlook Park viewing platform. These mitigations would be in addition to a data recovery effort at the Buckman townsite. All workers conducting maintenance activities would be educated regarding cultural resources in the project area, appropriate avoidance measures, and associated restrictions per Federal statutes.

Direct effects from operation and maintenance of the diversion facilities would be unlikely since most activities would take place within areas already disturbed by construction activities. The introduction of modern buildings and machinery would affect the visual setting of the townsite of Buckman; however, the facilities would be designed to complement the historic use of the area, thereby reducing the effect. With this mitigation measure in place, the facilities would not change the NRHP eligibility of the site. Indirect effects on cultural resources both in and outside the project area could include an increase in vandalism or illegal artifact collecting due to the presence of maintenance workers in the area. Maintenance activities would also increase the chances for inadvertent physical harm to cultural resources.

Direct and Indirect Effects of the Sediment Facility Alternatives

The following discussion compares the effects of two alternatives with those of the Proposed Action.

Construction Effects. Alternative SF1 would place the sediment facility and Booster Station 1A in a location off of the Buckman townsite. There are no known cultural resources in this new location. This would remove much of the effects of the Proposed Action on the NRHP-eligible Buckman townsite. The townsite would still be affected by the pipelines going to and coming from the sediment facility and booster station. However, pipeline trenches are narrow and excavation of them would effect the townsite much less than construction of the sediment facility and Booster Station 1A. Also, the return flow pipeline would affect the railroad grade under this alternative, whereas under the Proposed Action, this pipeline could avoid the grade.

Alternative SF2 would place the sediment facility and Booster Station 1A in a location off of the Buckman townsite and would not use a return flow pipeline, resulting in even fewer effects to the townsite of Buckman and the railroad grade. However, because this alternative would use trucks to haul the sediment offsite, the road would require more improvements, including widening and straightening, thereby expanding the area affected by road construction activities and increasing the possibility to impact buried archaeological sites.

Indirect effects from construction of either of the two alternatives would be similar to those arising from the Proposed Action.

Operation Effects. Alternative SF1 and SF2 would have less of a visual effect on the historical character of the Buckman townsite because the sediment facility and booster station would not be located within the townsite. SF2 would have more of a periodic visual and audible effect on the historical character of the Buckman townsite because of the noise and dust from trucks hauling sand from the sediment facility on a regular basis. Indirect effects of operation under any of the two alternatives would be similar to those arising from the Proposed Action.

Direct and Indirect Effects of the Pipeline Route Alternatives

Construction Effects. Alternative RWP1 would use one pipeline instead of two for the raw water conveyance between Booster Station 1A and Booster Station 2A. The pipeline route would be the same as under the Proposed Action, and thus, like the Proposed Action, it would impact the Buckman townsite and railroad grade. However, by using just one pipeline instead of two, a single trench instead of two would be excavated, thereby reducing the extent of the effects. Alternative TWP1 would physically affect site LA 138574. Alternative TWP2 would not directly affect any cultural resources. Alternative TWP3 would cross the railroad grade in four places. This is compared to the TWP under the Proposed Action, which would physically affect sites LA 138574 and LA98690. Indirect effects caused by construction of any of the alternatives would be similar to those resulting from the Proposed Action.

Operation Effects. There would be no direct effects to cultural resources under any of the alternatives since maintenance activities would take place within the areas already disturbed by construction activities. Indirect effects of operation under the alternatives would be similar to those arising from the Proposed Action.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction Effects. Alternative AGP1b would use an above ground power line between the existing Buckman substation and the river, instead of an underground power line. It is likely that all identified cultural resources, with the exception of the Buckman townsite, would be avoided during construction of the power line. While the areal extent of the Buckman townsite would require placement of at least one power line structure within its boundaries, the extent of physical disturbance to the townsite would be greatly reduced in comparison to the Proposed Action's underground power line. Because the power line would be above ground, it is likely that direct physical impacts to resources in this portion of the alternative's project area would be avoided by placing the structures away from any identified resources. Indirect effects caused by construction of Alternative AGP1 would be similar to those resulting from the Proposed Action. AGP1a would not impact cultural resoures.

Operation Effects. There would be no direct physical effects to cultural resources under Alternative AGP1 because maintenance activities would take place within the areas already disturbed by construction activities. The introduction of an above ground power line near the river would result in greater impacts to the visual setting of the townsite of Buckman as compared to the Proposed Action's underground power line. Indirect effects of operation under the alternative would be similar to those arising from the Proposed Action.

Cumulative Effects

The project area has undergone development in the past, in the form of overhead and underground utilities, water development, and roads. A railroad, road, power lines and pipelines have all been constructed through the Buckman corridor. The area has also been used in the past for grazing and off-road vehicle use, and is currently accessed by the public for recreation. All of these activities have likely resulted in some level of adverse effect to the cultural resources in the project area; however, due to the surficial nature of some of the activities, and the small amount of acreage of those activities that involved ground disturbance, the effects overall have been minimal. The region surrounding the southern portion of the project area has undergone development in the recent past, and this trend for constructing housing developments would likely continue in the region in the future. Effects to cultural resources from these housing developments are much more extensive and intensive than the likely effects assessed for this proposed water development project. The effects to cultural resources caused by the Proposed Action or the alternatives would be additive, but minimal.

Recreation Resources and Traffic

Affected Environment

The recreation opportunity spectrum (ROS) is a system used by the FS and BLM to stratify and define classes of outdoor recreation opportunity environments or settings provided on agency regulated lands. Recreation opportunities, according to this system, can be expressed in terms of three principal components: activity, setting, and experience. Possible mixes of activities, settings, and recreation experience have been arranged along a spectrum, ranging from primitive to urban (BLM 1988). There are six major ROS setting categories within the ROS system. The ROS setting categories arranged in order from urban to primitive are as follows: Urban, Rural, Roaded Natural (RN), Semi-Primitive Motorized (SPM), Semi-Primitive Non-Motorized (SPNM), and Primitive. The setting categories are constructed to display the range from very developed and convenient (Urban) to very remote and wild (Primitive).

The ROS provides seven descriptors to differentiate among the various setting categories. These descriptors give agencies evaluation tools for monitoring the success of management efforts. In addition, agency personnel can use these descriptors to guide decisions on site development proposals. Furthermore, public lands visitors can use the descriptors to evaluate whether a particular destination on Federal land offers the setting that matches their expectations. Descriptions of conditions are evaluated by whether they are fully compatible with an ROS expectation. The range of evaluation levels continues through levels termed "compatible," "norm," "inconsistent," and "unacceptable." Thus four levels are available to describe how well a given setting fits with the national standards set by the ROS. For instance, "norm" defines the typical conditions when a given setting is managed according to national standards. The term

"inconsistent" highlights some incompatibility between ground conditions and standards. Some situations are left inconsistent with national standards because they meet local management objectives. When conditions fall into the "unacceptable" level, significant management changes are necessary to bring the setting into its desired state. If those changes are not possible (such as is the case along the Buckman utility corridor managed as a Semi-Primitive Non-Motorized setting), the agency may consider changing the allocation to fit actual ground conditions.

The descriptors are as follows:

1. Access: The access descriptor depicts the type and mode of travel compatible within each setting category.
2. Remoteness: The remoteness descriptor defines the perception of being removed from the sights and sounds of human activities.
3. Naturalness: The naturalness descriptor illustrates the physical conditions of the setting as compared to a natural environment. This descriptor is primarily a visual evaluation of the surrounding landscape and describes the level of human modifications that has occurred or is proposed.
4. Social Encounters: The social encounters descriptor attempts to define the appropriate frequency of meeting others during the course of a day's activities within an area with a particular setting category.
5. Visitor Impacts: The visitor impacts descriptor describes the physical change that human use produces in the environment. This descriptor focuses on how much change will be allowed and what tools for control are appropriate, rather than how impacts can be prevented.
6. Visitor Management: The visitor management descriptor focuses on the amount of regulation and control, plus the level of information and services, provided to visitors. More developed settings offer sufficient regulation and services to provide a necessary level of security for visitors; whereas, a primitive setting lacks such management, demanding independence and a level of risk taking.
7. Facilities and Site Management: The facilities and site management descriptor refers to the level of site development, in that urban and rural settings provide more convenience and comfort with more developed facilities than primitive settings where facilities are absent.

The area of potential effect for recreation resources includes contiguous river segments and reservoirs from Heron Reservoir in northern New Mexico to Cochiti Reservoir in central New Mexico, as well as the Buckman Road/Dead Dog Leg corridors and adjacent lands. Recreational use across these lands varies, based on location, activity, access, and water source. Therefore, an overview of relevant corridors, river reaches, and reservoirs with their associated recreational uses are presented below.

Corridors

Originating at Otowi Bridge and continuing through the project area near the terminus of Buckman Road is a primitive, unmaintained pack trail. The pack trail crosses FS land under Management Area G (managed for a Recreation Opportunity Spectrum (ROS) setting of Roaded Natural and Semi-Primitive Motorized (FS 1987)) directly adjacent to, and within, the project area. It then continues south on FS Management Area L land that is managed for a ROS setting of

Semi-Primitive Non-Motorized (SPNM) (FS 1987). This trail system is typically used by cyclists, campers, picnickers, birders, rockhounds, horseback riders, hikers, and off-highway-vehicle (OHV) users. OHV use on FS lands under Management Area G is legal; however, on Management Area L land adjacent to Area G in the project area, it is illegal.

Management Area G in the project area includes objectives for both Semi-Primitive Motorized and Roaded Natural. In the Buckman area along the road and to the river, well buildings and other facilities are consistent with Roaded Natural, while other descriptors are consistent with Semi-Primitive Motorized (SPM). A full list of descriptors is provided in Table 17.

The current management objectives with ROS for BLM lands along Buckman Road are Semi-Primitive Non-Motorized, meaning OHV use is limited to existing roads and trails (BLM 1988). The southern portion of BLM managed lands, about a mile south of Alamo Creek, is assigned Rural, where frequent social interactions and more cultural modifications to the environment are acceptable (BLM 1988). Within the project area, the RMP designates existing roads (such as Buckman Road) as open to vehicle use; however, the emphasis for SPNM is to provide opportunities for challenge and solitude.

For BLM lands, the actual existing recreation setting along Buckman Road and south of Alamo Creek is better described in Table 17 by each descriptor. As illustrated, all descriptors are not completely consistent with management objectives for SPNM. Some exceed the standard, and others fall short of standards. BLM direction allows for variance from these standards when local objectives are taken into account. The criteria used to make these evaluations are taken from the 1990 ROS Primer and Field Guide and Appendix C of the 2001 “Built Environment Image Guide” (FS-710).

The Taos RMP provides overall management objectives for recreation in this area. During the revision process for the RMP, scheduled to begin in 2006, the ROS setting categories for this Buckman area will be re-evaluated and adjusted where necessary to reflect existing and future potential conditions.

Buckman Road is a narrow, unpaved, County maintained rural road primarily intended for low volume vehicle use. The unpaved segment of the road is approximately 9.2 miles long. Buckman Road serves as the only access to the Rio Grande in the Española Ranger District. In order to quantify current recreational use along Buckman Road, a mechanical vehicle counter was buried under the road surface just north of Dead Dog Well for approximately 1 month, and two separate daylong traffic surveys were conducted near the counter. The data indicates that approximately 19 vehicles per weekday visit Buckman, of which nearly 50 percent do so for recreational purposes. Approximately 50 vehicles per weekend day visit Buckman, of which approximately 95 percent do so for recreational reasons. This data does not necessarily represent yearlong use patterns.

Along Buckman Road and the Dead Dog Leg maintenance road, recreation opportunities include picnicking, camping, hiking, biking, OHV use, caving, rock climbing, fishing, target shooting and hunting (illegal on FS land directly adjacent to the project area except T17N, R8E, Section 9; legal on BLM land provided that all State and Federal laws and regulations are followed), wildlife viewing, piñon nut and firewood gathering, recreational driving, photography, and partying. Recreation along the Dead Dog Leg corridor is far more limited relative to Buckman Road. There are no developed recreation resources or opportunities along the Buckman or Dead Dog Leg corridors.

Table 17. ROS existing conditions.

	ROS Descriptor	Along Buckman Road	About 1 mile South of Alamo Creek
BLM Managed Lands	Access	Improved, double-lane road: Roaded Natural	Two-track: Semi-Primitive Motorized
	Remoteness	Too close to improved roads and higher density travel and visitation: Roaded Natural	Too close to improved roads and higher density travel and visitation: Roaded Natural
	Naturalness	Vegetative manipulation not apparent: Semi-Primitive Motorized	Vegetative manipulation not apparent: Semi-Primitive Motorized
	Social Encounters	Low to Moderate: Semi-Primitive Motorized	Low: Semi-Primitive Motorized
	Visitor Impacts	Subtle compaction and vegetation loss from visitors at all sites: Roaded Natural	Limited site hardening: Semi-Primitive Motorized
	Visitor Management	Only fencing and signing of ownership: Semi-Primitive Motorized	No controls: Semi-Primitive Motorized
	Facilities & Site Management	Many utilities, power lines, water tanks, pumps, substations: Urban	Visible power lines: Semi-Primitive Motorized
		Along Buckman Road	**River Access**
Forest Service Managed Lands	Access	Improved, double-lane road: Roaded Natural	Two-track: Semi-Primitive Motorized
	Remoteness	Close to improved roads and higher density travel and visitation: Roaded Natural	Close to improved roads and higher density travel and visitation: Roaded Natural
	Naturalness	Vegetative manipulation not apparent: Semi-Primitive Motorized	Vegetative manipulation not apparent: Semi-Primitive Motorized
	Social Encounters	Moderate: Roaded Natural	Moderate: Roaded Natural
	Visitor Impacts	Subtle compaction and vegetation loss from visitors at all sites: Roaded Natural	Subtle compaction and vegetation loss from visitors at all sites: Roaded Natural
	Visitor Management	Only fencing and signing of ownership: Semi-Primitive Motorized	Only fencing and signing of ownership: Semi-Primitive Motorized
	Facilities & Site Management	Some utilities, power lines, well buildings: Roaded Natural	Some utilities, powerlines, well buildings: Roaded Natural

All existing infrastructure located along Buckman Road and the Dead Dog Leg maintenance road is well within the range of firearms and shows signs of vandalism. On May 24, 2001, Closure Order No. 10-251 was signed by the FS prohibiting the discharge of a firearm, air rifle, gas gun (paintball gun), shooting bow and arrow, or anything that can harm others or their property within 1 mile of the forest boundary on all sections comprising the eastern boundary of the Española

Ranger District Caja Subunit except in T17N, R8E, Section 9, which is directly adjacent to the Dead Dog Leg corridor (FS 2001a).

The staging area for Caja Del Rio "Diablo" Canyon consists of an unimproved, unmaintained dirt parking lot that is accessed from Buckman Road. The Diablo Canyon staging area provides parking and access to the canyon and Cañada Ancha for rock climbers, horseback riders, hikers, runners, rock hounds, wildlife viewers, firearms users, spelunkers (cavers), partiers, and a host of other pursuits.

River Reaches

Three river reaches are included in the area of potential effect from the Buckman Project.

The Rio Chama below Heron Reservoir to Abiquiu Reservoir is at the northernmost extent of the area of potential effect and is primarily a brown trout/rainbow trout fishery. A 5.5-mile scenic trail along the Rio Chama connects El Vado Reservoir with Heron Reservoir. Commercial and private boating operations have been regulated for safety and congestion reasons on this reach of the Rio Chama, to maintain wilderness quality. Both the BLM and FS cooperatively manage this segment of the Rio Chama. BLM handles the river permit system while the FS manages the land. Depending on the time of year and the schedule of dam releases upstream, San Juan-Chama Project waters, along with MRGCD water for irrigation demands, can make up a sizeable percentage of this recreationally utilized flow.

The Rio Chama below Abiquiu Reservoir to the confluence with the Rio Grande is also north of the project area and is in the middle reach in the area of potential effect. This river segment primarily supports a naturally reproducing brown trout fishery. The first 7 miles below Abiquiu Dam are designated by the New Mexico Department of Game and Fish as "special trout water." This fishery is prevented from developing due to the unreliability of the outflow from Abiquiu Reservoir, as well as water quality issues. Limited boating on this lower reach of the Rio Chama also occurs, although no commercial outfitters guide this stretch.

The ROS category for these two reaches of the river range from Primitive in the wilderness to SPNM, SPM, or Rural (along highways). The project will affect streamflows in these reaches to a small degree, but effects to descriptors are not expected; therefore, ROS for these reaches will not be discussed further.

The Rio Grande from the Rio Grande/Rio Chama confluence to Cochiti Lake is the southernmost reach potentially affected by the project. This reach is approximately 15 miles long and is primarily a brown trout, smallmouth bass, and channel catfish fishery. Commercial and private boating operations occur on the lower, canyon-bound reach of this segment of the Rio Grande in White Rock Canyon. Special use permits must be obtained from the FS in order to commercially guide tours through White Rock Canyon. The put-in for White Rock Canyon is at the terminus of Buckman Road. ROS at the terminus of Buckman Road (at the river) is consistent with Roaded Natural because of the existing facilities (wells and utility lines).

Reservoirs

Four reservoirs are included in the area of potential effect from the Buckman Project. Heron Reservoir is at the northernmost extent of the area of potential effect. El Vado and Abiquiu Reservoirs are in the middle reaches, and Cochiti Reservoir is at the southern extent of areas

potentially affected by the project. Each reservoir has facilities that support a wide array of waterborne recreation activities including boating, swimming, and fishing. None of the actions have potential to affect the ROS setting for these reservoirs because only a small variation in reservoir levels would occur, which would have negligible potential to change the ROS descriptors.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, developed and undeveloped recreation opportunities and resources at the reservoirs, river reaches, and immediate project area would not be affected. Actions related to diversion of San Juan-Chama water would not occur. Flow characteristics in the Rio Grande related to the release of San Juan-Chama contract water for use by the City and County of Santa Fe would continue to be affected by the rate of Buckman well pumping and related releases of offsetting San Juan-Chama Project water (currently approximately 2,500-3,000 ac-ft/yr). Project-related improvements to Buckman Road would not take place. Therefore, no direct or indirect short- or long-term effects to recreation opportunities or resources would occur from the implementation of the No Action Alternative.

Direct and Indirect Effects of the Proposed Action

Construction Effects. During construction operations, road improvements may delay access along part or all of Buckman Road and/or the Dead Dog Leg maintenance road. Burial of raw water pipe lines, gas lines, and power transmission lines under or near Buckman Road would result in a short-term direct negative effect to recreational access for the duration of construction. Examples of these short-term effects would be increased noise levels and delayed access to the river. Therefore, construction activities along the Buckman and Dead Dog Leg corridors associated with the Proposed Action would include access and safety controls, where practical for users.

Buckman Road would not be closed during construction related to the Proposed Action. Therefore, the public would have to share the road with construction traffic and may experience traffic delays during the 12-month Buckman Road construction schedule. The mitigations that would be implemented to notify the public of the potential to encounter construction traffic include use of construction road signs and flagmen, which would serve to protect the area user during construction. Additionally, due to safety considerations, public access to the Rio Grande at the construction site may be limited during the 5-month water diversion construction.

Operation Effects. Following construction, the improved Buckman Road would allow low clearance vehicles to negotiate the road more conveniently and could indirectly increase the usage levels of the Buckman and Dead Dog Leg corridors and surrounding land. While speculative, increased access could result in a greater incidence of vandalism, target shooting (both legal and illegal), illegal OHV use, as well as other undesirable activities resulting in harassment of law-abiding visitors. The County would undertake maintenance of Buckman Road; therefore, maintenance vehicles and/or grader traffic would increase slightly based on necessary maintenance and repair schedules.

The criteria used to make these evaluations are taken from the 1990 ROS Primer and Field Guide and Appendix C of the 2001 "Built Environment Image Guide" (FS 1990 and USDA 2001).

Improvements to Buckman Road as part of the Proposed Action would affect to a small degree the recreation experience on both BLM and FS lands. The effects can partly be described in terms of the changes to the ROS setting. However, because the BLM land classification of SPNM is not consistent with current conditions, additional description is required. These FS and BLM lands are along the Buckman and Dead Dog Leg corridors.

On the SPNM BLM lands along Buckman Road, the Access and Naturalness ROS descriptors would be affected due to the use of aggregate, vegetative manipulation, and curve straightening. Cumulative affects to social encounters, visitor impacts, and visitor management could result as well. Social encounters could increase as a result of road improvements, which could increase loss of vegetation and site hardening to compensate for increased visitation. Another possible outcome would be that management controls could be applied to offset visitor impacts. Improvements to the road would move the condition further from the existing management objectives of SPNM.

On BLM lands south of Alamo Creek, the WTP, power line, and substation would change the existing condition to all but two of the ROS descriptors. This would be consistent with BLM objectives except for the access descriptor.

Table 18. Effects to ROS conditions from Proposed Action and alternatives.

	ROS Descriptor	Along Buckman Road	~1 mile South of Alamo Creek
BLM Managed Lands	Access	Improved, double-lane road with aggregate: Rural	Improved road, aggregate and paved: Rural/Urban
	Remoteness	Too close to improved roads and higher density travel and visitation: Roaded Natural	Too close to improved roads and higher density travel and visitation: Roaded Natural
	Naturalness	Highly modified by vegetative manipulation and curve straightening, especially near Diablo Canyon: Rural	Vegetative manipulation dominant in foreground: Roaded Natural/Rural
	Social Encounters	Low to moderate but may increase due to road improvements: Roaded Natural	Moderate to high due to personnel and maintenance: Roaded Natural
	Visitor Impacts	Subtle compaction and vegetation loss from visitors at all sites – could increase due to possible increased visitation: Roaded Natural	Subtle hardening dominant: Roaded Natural
	Visitor Management	Only fencing and signing of ownership – may increase to offset visitor impacts: Semi-Primitive Motorized/Roaded Natural	No controls: Semi-Primitive Motorized
	Facilities & Site Management	Many utilities, power lines, water tanks, pumps, substations: Urban	Obvious and numerous facilities: Rural/Urban

		Along Buckman Road	River Access
Forest Service Managed Lands	Access	Improved, double-lane road with aggregate: Roaded Natural	Two-track: Semi-Primitive Motorized
	Remoteness	Close to improved roads and higher density travel and visitation: Roaded Natural	Close to improved roads and higher density travel and visitation: Roaded Natural
	Naturalness	Vegetation manipulation dominant in the foreground: Roaded Natural	Vegetative manipulation dominant in foreground near river: Roaded Natural
	Social Encounters	Moderate but may increase due to road improvements: Roaded Natural	Moderate but may increase due to road improvements: Semi-Primitive Motorized/Roaded Natural
	Visitor Impacts	Subtle compaction and vegetation loss from visitors at all sites – could increase due to possible increased visitation: Roaded Natural	Subtle compaction and vegetation loss from visitors at all sites – could increase due to possible increased visitation: Roaded Natural
	Visitor Management	Only fencing and signing of ownership – may increase to offset visitor impacts: Semi-Primitive Motorized/Roaded Natural	Only fencing and signing of ownership – may increase to offset visitor impacts: Semi-Primitive Motorized/Roaded Natural
	Facilities & Site Management	Power lines, well buildings, sediment facility and booster station visible but designed to blend, not dominate: Roaded Natural	Well buildings plus diversion structure and power lines visible, but designed to blend in, not dominate: Roaded Natural.

On National Forest System lands along Buckman Road, the Access and Naturalness ROS descriptors would be affected due to the use of aggregate and vegetative manipulation. As with the BLM lands, cumulative affects to social encounters, visitor impacts, and visitor management could result as well. Social encounters could increase as a result of road improvements, which could increase loss of vegetation and require site hardening to compensate from increased visitation. Another possible outcome would be that management controls could be applied to offset visitor impacts. Improvements to the road and the river diversion would remain within Roaded Natural objectives.

The negative effects would be partially mitigated by the use of colored additives in the concrete at all dip sections to minimize the visual contrast with the existing landscape (Figure 15). For example, signs marking speed limit and curves would require construction in a manner compatible with a Roaded Natural setting by constructing both sign and support post from solid wood (or appearing so—avoid metal, fiberglass or other synthetics) and have a natural or stained finish. Also, apparent disturbance to vegetation (slash piles, etc.) would be restored within between 1 to 2 years unless left as wildlife habitat piles.

Under the Proposed Action, the Rio Chama below Heron Reservoir to Abiquiu Reservoir and the Rio Chama below Abiquiu Reservoir to the confluence with the Rio Grande would each experience slight discharge fluctuations from project related releases. The additional release of approximately 28 cfs during peak demand releases would have minor effects to the hydraulic

characteristics of the Rio Chama. Recreation resources would not be noticeably affected. Therefore, developed and undeveloped recreation opportunities (boating, swimming, camping, hiking, etc.) and resources along these segments of the Rio Chama would not experience direct or indirect short- or long-term negative effects.

Effects to the segment of the Rio Grande above the project area are expected to be the same as for those discussed above for the Rio Chama segments.

At the diversion site, boaters would be required to navigate away from the diversion structure where it extends into the Rio Grande. However, at this location the river is 50 to 60 feet across, and the diversion structure would only extend into the river approximately 15 feet. Thus, boaters should be able to readily avoid the structure.

The segment of the Rio Grande below the project area would not benefit from the addition of project-related San Juan-Chama water discharge. However, the reduced discharge would not be discernible. This is because the San Juan-Chama discharges for the Albuquerque diversion would also be occurring and the Buckman amount is relatively small compared to the Albuquerque amount. In addition, nonwater-based recreation users are not directly dependent on streamflows. Therefore, no direct or indirect short- or long-term negative effects to recreation opportunities or resources would result on the Rio Grande and surrounding land below the project area.

Under the Proposed Action, reservoirs would all experience a slight fluctuation in storage from project-related discharges. Water levels at these reservoirs plays an important role in the recreation opportunities available, and a change in water levels could affect recreation opportunities. However, project-related discharges (approximately 28 cfs at peak demand) would result in a 1-inch fluctuation at the reservoirs and would not be large enough to negatively affect the volume of water stored at the reservoirs. Therefore, no direct or indirect short- or long-term negative effects to developed or undeveloped recreation opportunities or resources at Heron, El Vado, or Abiquiu Reservoirs or Cochiti Lake would occur.

Direct and Indirect Effects of the Sediment Facility Alternatives

Construction Effects. Specific construction effects to recreation resources and opportunities under Alternative SF1 and SF2 are expected to be the same as for the Proposed Action.

Operation Effects. Operation effects to recreation resources and opportunities due to Alternative SF1 are expected to be the same as for the Proposed Action. Under Alternative SF2, where the coarse river sediment would be trucked out and disposed of at an offsite facility, Buckman Road users could encounter heavy truck traffic. During periods when sand is hauled out of the facilities, the recreation experience and SPNM, SPM/Roaded Natural setting sought by visitors to the Buckman and Dead Dog Leg corridors would be degraded by the additional truck traffic, but because the current experience includes existing traffic associated with the City and other facilities, the actual change in setting is expected to be slight.

Direct and Indirect Effects of the Pipeline Route Alternatives

Construction and Operation Effects. Specific effects to recreation resources and opportunities under all pipeline route alternatives are expected to be the same as for the Proposed Action.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. Alternative AGP1 effects would be similar to the Proposed Action for the power upgrade.

Cumulative Effects

The Albuquerque Drinking Water Project would add San Juan-Chama water to the Rio Chama and Rio Grande south to Albuquerque. The City of Española and Pueblo of San Ildefonso proposed projects would add San Juan-Chama water to the Rio Chama south to approximately the confluence with the Rio Grande. The Buckman Project would add San Juan-Chama water to the Rio Chama and Rio Grande south to the proposed diversion site. These projects, when considered together, would result in increased year-round flow in the Rio Chama, Rio Grande, and the four reservoirs from Heron Dam to the proposed diversion structure at Paseo del Norte. This would have beneficial effects to recreational opportunities in the project area. The Buckman Project would add to this cumulative effect from Heron Dam to the proposed Buckman diversion facility.

The Supplemental Well Project, combined with this Buckman Water Diversion Project, would increase access to the project area for recreational purposes through improvements in existing access and development of new access. This would be beneficial for recreational opportunities. However, the use of acreage for above ground facilities, such as well heads, sedimentation ponds, and booster stations, would remove areas from recreational use and would negatively affect the overall recreational experience of the rest of the area. The anticipated future development of residential areas nearby would add to the negative effects. The Buckman Project would be additive to these beneficial and negative effects.

Scenic Resources

In general, scenery is the aggregate of visual and auditory (noise) features that give character to the landscape and is an integrated part of ecosystem management. All lands administered by the BLM and FS are managed to achieve a specific level of visual or scenic quality. The two Federal agencies use different systematic processes to analyze the potential visual effects of proposed projects and activities. Both of these management systems are processes to provide resource managers with a method of determining visual values on Federally managed lands. The BLM's Taos Field Office Resource Management Plan is silent regarding visual management objectives in the Buckman Project area. Conversely, the FS has defined management objectives, as specified in the Santa Fe National Forest Management Plan, for FS lands within the area of the proposed Buckman Project.

In 1995, Santa Fe County published a report that evaluated and presented the results of a visual resources analysis of Santa Fe County. The study relied on both public and expert evaluation in identifying areas within the County that have significance for visual reasons. This study was initiated by the County because of widespread concern for the loss of scenic quality in the County (Santa Fe County 1995).

BLM Visual Resource Management System. BLM uses a Visual Resource Management (VRM) system. The VRM system includes a visual resource inventory, which classifies visual resources on BLM land into one of four categories (Class I, II, III, or IV), and sets management objectives through a resource management plan process. The inventory consists of a scenic quality evaluation, sensitivity level analysis, and a delineation of distance zones. Based on these

three factors, BLM-administered lands are placed into one of the four VRM classes (BLM 1986a). In addition to inventory data, the VRM classes can reflect management considerations.

Table 19. VRM Classes and Management Objectives.

BLM Visual Resources Management Class	Management Objectives
Class I	Provides for natural ecological changes; however, it does not preclude very limited management activities. Level of change should be very low and must not attract attention.
Class II	Retain the existing character of the landscape. Management activities may be seen, but should not attract the attention of the casual observer.
Class III	Partially retain the existing character of the landscape. Level of change should be moderate but not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
Class IV	The objective of Class IV is to provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. Management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

(Source: BLM 1986)

Each VRM class describes a different degree of modification allowed in the basic elements (form, line, color, and texture) found in the predominant natural features of the landscape. Table 19 provides additional information regarding the management objectives for the various VRM classes.

The Taos Field Office has not classified the Buckman area for visual resources through the Resource Management Plan. Consequently, a preliminary visual resources field inventory was conducted in December 2002 in the project area. The inventory was limited to the area potentially affected by the project and is not as comprehensive as a formal resource inventory would be. The survey results are to be used only as a strong indication of the appropriate inventory class of public lands within the Buckman Project. Based on results of the field survey at the three primary locations of interest, the following VRM classes are preliminarily indicated.

- *Diversion and Sediment Facility.* The water diversion structure and sediment facility were viewed from White Rock Overlook Park's observation platform. This evaluation was conducted because BLM lands may be viewed from the White Rock Overlook Park observation platform. However, most scenery effects would occur directly on FS lands. The Buckman Project site would qualify under BLM criteria as a Class III.
- *Buckman Road and Dead Dog Well Corridors.* Substantial sections of the Buckman Road and Dead Dog Well corridors would qualify as Class IV. However, the section within a mile on either side of the Diablo Canyon staging area (parking area) would qualify as a Class III resource.

- *MRC WTP.* This site could qualify under BLM criteria as a Class III if evaluated from a foreground-middle ground zone or a Class IV if judged by background zone criteria. Generally, this site is expected to be viewed from a distance due to lack of site visitation.

FS Scenery Management System. The FS uses a Scenery Management System (SMS) that evolved from and replaces the Visual Management System (VMS) defined in Agricultural Handbook 462 (FS 1995). Corresponding SMS and VMS levels for existing scenic conditions and visual quality objectives (VQO) are compared in Table 20. Basically, the two systems differ in that the SMS emphasizes and increases the role of constituents throughout the inventory and planning process; and it borrows from and is integrated with the basic concepts and terminology of ecosystem management. The SMS provides for improved integration of aesthetics with other biological, physical, and social/cultural resources in the planning process. Thus, the SMS actually incorporated additional factors when evaluating potential scenery effects and does not exclude any VMS factors.

Table 20. Definition of terms and corresponding levels of existing scenic conditions between the Visual Management System and the Scenery Management System.

FS - Visual Management System	FS - Scenery Management System	Existing Landscape Character Being Viewed	Acreage of Management Area G
Preservation	Very High	Landscape character is intact with only minute, if any, deviations.	0
Retention	High	Deviation may be present but blends in with the landscape character so they are not evident.	12,199
Partial Retention	Moderate	Landscape appears slightly altered.	40,144
Modification	Low	Landscape character appears moderately altered.	27,444
Maximum Modification	Very Low	Landscape character appears heavily altered.	147,205
No Corresponding Term	Unacceptably Low	Landscape character appears extremely altered.	NA

(Source: FS 1995)

The SMS process and terms are used in this analysis and, when necessary, VMS terms have been converted to the appropriate SMS term.

According to the Forest Plan, areas viewed in the foreground from communities, recreation areas, and high use roads and water bodies, as well as scenic backdrops from these areas, would have a management objective of "High." Therefore, management activities would not be visually evident within 1 year of project completion.

Backdrops of less scenic quality or lands viewed in the foreground from lower use areas have a management objective of "Moderate." Here, activities may be evident, but must remain subordinate to the characteristics of the landscape (FS 1987).

FS lands with the potential to be directly affected by the project lie within Management Area G. Management Area G is managed for visual quality objectives according to the levels identified in the forest visual resource inventory. Emphasis in this management area is on key wildlife habitat protection, habitat improvement, and forage and firewood production. Lands within Management Area G meet the categories of "Low" to "Moderate," as the landscape currently appears slightly to moderately altered. Contiguous with Management Area G and in close proximity to the proposed project water diversion structure is Management Area L. Management of Area L focuses on maintaining semiprimitive nonmotorized recreation opportunities and providing the user with a moderate to high probability of experiencing isolation from the sights and sounds of humans. Thus, landscape deviations may be present but they blend in with the landscape character so they are not evident, and the management priority on maintaining this condition is "High."

All proposed work that would be on Las Campanas, City, or County lands are compatible and compliant with existing land use plans or zoning ordinances. For the most part, existing utility corridors would be used for installation of the water distribution system on their lands.

Affected Environment

People are concerned with the quality of their environment, including aesthetic values of landscapes, particularly scenery and spiritual values. Scenery with natural appearing landscapes enhances people's lives and benefits society. Natural appearing landscapes serve as psychological and physiological "safety valves" for increasing urban population pressures and the increasing complexity of life (FS 2002). The following section is descriptive of the proposed project region.

Viewsheds. White Rock Canyon is the most striking landform feature at the terminus of Buckman Road. Here, the Rio Grande has incised its channel approximately 750 feet through overlying columnar jointed basalt. To the north is a prominent mesa called Buckman Mesa. Buckman Mesa is characterized by dark colored basaltic cliff bands at the upper elevations and aprons of talus and sediment that surround the entire structure. The Cañada Ancha is the principle drainage corridor for all lands surrounding the Buckman Road corridor. A component of Cañada Ancha and approximately 2.5 miles southeast of the Buckman Road terminus at the Rio Grande, there is a small, visually distinct canyon called Caja del Rio Canyon (Diablo Canyon). This area is readily viewed by recreational users including Rio Grande recreationists. Individuals using the northern portions of the White Rock Rim Trail, which is accessed from the residential neighborhoods in White Rock (Los Alamos County), and users of White Rock Overlook Park would also be afforded views of the Buckman Road terminus and adjacent terrain.

The natural environment at the proposed Buckman water diversion site consists of the Rio Grande and vegetation comprised of flood plain-plains riparian assemblages along the Rio Grande shoreline. Historically, along the Rio Grande in the project area, a settlement was established in 1889 and named for H. F. Buckman who cut timber and built sawmills on Pajarito Plateau. Buckman was also a station on the Chili Line or Denver and Rio Grande narrow gauge railroad that ran between Santa Fe and Antonito, Colorado. The current manmade environment of the Buckman Well Field includes booster stations and associated water tank, dirt and two-track

roadways, and power lines. These structures are readily visible to site users and those using the White Rock observation platform. This area serves as a parking area for recreational users. Therefore, the scenic integrity appears slightly to moderately altered and the FS management regime would be consistent with the categories of "Low" to "Moderate." However, the FS Forest Plan specifies a "High" management value for recreation areas and water bodies. The current structures present at Buckman are evident, with the exception of Well No. 8, and do not adequately repeat the form, line, color, texture, and pattern common to the landscape character. Thus, the FS Forest Plan and actual site conditions appear in conflict. Many of the structures were built prior to completion of the 1987 FS Forest Plan and, therefore, were not out of compliance with the plan when originally constructed. Well No. 8 was constructed after issuance of the FS Forest Plan and blends in well with the landscape of the area.

Sights along the Buckman roadway range from: dense stands of piñon/juniper woodlands to open meadows; surface developments such as booster stations and electrical substation; utility corridors that parallel the road along its entire length; livestock grazing; and off-road vehicles in the area. On the east side of the Buckman Road corridor, there are low relief, rolling hills that are characterized by piñon/juniper woodlands typical of the surrounding hills in the area. Watercourses through these hills exhibit a dendritic pattern and flow only when thunderstorms or water surpluses permit. The view to the west of Buckman Road around the Dead Dog Well area to the Rio Grande is of steep slopes leading up to a mesa top named Sagebrush Flats.

At Dead Dog Well the pipeline corridor splits. One route, Buckman Road, continues southeast toward Las Campanas paralleling utility corridors and booster stations and their associated water tanks. The other leg of the route continues south at Dead Dog Well and follows a utility corridor to the City of Santa Fe.

The MRC WTP is proposed for construction and operation on a small flat mesa in close proximity to Caja del Rio Road. The Sangre de Cristo Mountains to the east and Jemez Mountains to the west comprise the distant viewshed. Power lines, housing, and, depending upon the viewer's location, facilities of the MRC can be seen along with other City infrastructure in the distance. The vegetation of the mesa is herbaceous with a varying density of piñon/juniper woodlands.

The western distribution route follows the western edge of Highway 599 to connect with existing County water pipelines located at the intersection of the I-25 frontage road and Erica Road. The route traverses through disturbed industrial areas and roadway ROW that support little native vegetation. Current City plans for this area are for trails, parking, a rest area and benches.

Land Use. Land use within the general area is varied. Designated land uses include grazing, harvesting for firewood and small wood products, recreation, utility corridors and easements, water wells and booster stations, and recreation. There are numerous existing utility infrastructure ROWs along the Buckman Road corridor. These ROWs meander back and forth across Buckman Road as they traverse the terrain on their course southeasterly. All but one of these utilities is buried within the Buckman easement; there is a high-tension power line that parallels the corridor.

Lighting and Noise. The only local direct sources of lighting along the Buckman Road and Dead Dog Leg corridor are at the existing booster stations and an electrical substation. Both direct and indirect lights (unnatural nighttime sky glow) can be seen within the project area and are the result of lights from the nearby communities of Las Campanas, Santa Fe, and White Rock.

Existing noise levels in the study area vary according to adjacent development and activity levels. Relatively low noise levels are experienced throughout much of the study area due to its rural character, including the vacant and undeveloped lands associated with the Santa Fe National Forest and BLM. The low noise levels generated in these areas are attributed to distant aircraft, light traffic on Buckman Road, recreational activity, and typical natural background noises. Several existing booster stations associated with the Buckman Well Field are also present in scattered locations throughout the study area and generate audible noise. Somewhat higher noise levels occur adjacent to study area roadways and in the developing areas associated with Las Campanas and other subdivisions. FS property south of the proposed diversion site, Area L, is designated for nonmotorized use. However, motorized vehicles (on-road and off-road recreational vehicles) are commonly observed in Area L near the proposed diversion site.

Constituent Information

The visual resources inventory conducted by the County resulted in County constituents publicly nominating as an important scenic viewing point the view from the White Rock Overlook in Los Alamos County. The viewshed from White Rock is the Rio Grande Valley. Caja del Rio Canyon (Diablo Canyon) was nominated as a scenic place and Buckman Road was nominated in the scenic roads and trails category. This same study asked the public to rank 26 landscape character types from the most scenic (rank 1) to the least scenic (rank 26). The public ranked utility corridors as number 25, with only an industrial setting less scenic. Secondary roads and shrubland landscape character types were ranked 17 and 16, respectively (Santa Fe County 1995).

In support of BLM's VRM and the FS's SMS analysis, three data collection tasks were performed: White Rock Overlook Park observation platform interviews; Buckman Road vehicle counts by observations; and vehicle counts at Buckman Road using a mechanical counter. Data was collected in order to characterize the value people place on the Buckman water diversion site viewshed and the level of Buckman Road use as an indication of visitor use within the public lands of the proposed project area.

White Rock Overlook Park Interviews. Two interview sessions with the public visiting the White Rock Overlook Park observation platform located in the White Rock community of Los Alamos were performed. Each of the 113 people interviewed expressed comments as to the beauty of the surrounding area. All provided thematic adjectives such as pristine, breathtaking, spectacular, and other positive descriptions. However, there was a range of reaction regarding the potential modification of the Buckman area. The following statements illustrate the range:

Negative Reactions

"As you get older, you appreciate landscapes...start taking it away you'll never get it back. Don't develop."

"It will kill the point of coming out, we can see a built environment in Chicago too. This showcases the whole Southwest and is similar to the Grand Canyon."

"Leave it like it is [there are] fewer and fewer places of natural beauty."

Transitional Reactions

"Water is more of an issue than the build-out."

"Change the scenery...is it good or bad, difficult to answer."

"The [existing] power lines are more disruptive than a building."

Mitigative Reactions

"Buildings out there [you] don't really see at first, build with a historical context."

"Construction should blend in."

"[If] well done, [it] would not change dramatically the rest [viewshed] it is so big."

There were no responses from visitors that indicated the project should go forth without some sort of viewshed mitigation. Of note were several comments regarding how the existing power lines to the northeast of the viewing platform were very intrusive and detracted from the landscape; how the existing buildings east of the Rio Grande should be painted to blend in with the landscape; how the roadways that are constructed in straight lines draw attention to the manmade environment and disrupt the flow of the natural environment; and, when present, off-highway vehicle noise from east of the Rio Grande and in the local vicinity of the proposed Buckman diversion site was very noticeable and irritating, thereby, reducing the aesthetic experience.

Buckman Road Use. Data was collected specifically for this project via a mechanical vehicle counter and user observations. Average weekday use was approximately 19 vehicles while weekend use averaged about 50 vehicles per day. Survey data indicated that approximately 50 percent of the weekday use is work related while the vast majority of weekend users were there for recreational purposes.

Environmental Consequences

The preponderance of project effects would occur from the construction and operation of facilities on BLM and FS lands. Proposed scenery mitigations specify that the project structures would be designed to incorporate the color, form, texture and line of the surrounding landscape. Thus, the proposed project would be compatible with BLM's VRM and the FS's SMS objectives. Noise environmental consequences are addressed in the following section, "Noise."

No Action Alternative

There would be no effects to scenic resources if the proposed project is not constructed. No new structures would be built and no new scenic elements would be introduced.

Direct and Indirect Effects of the Proposed Action

Construction Effects. Construction activities at the Rio Grande and immediately adjacent areas would be noticeable by site users and visitors to the White Rock Overlook Park observation platform. Visual or aesthetic effects and increased noise levels would be a consequence of construction of the cofferdam and other facilities and infrastructure, construction equipment movement and noise, and removal of vegetation. These effects would be short term and last for the approximate 5-month construction schedule. Similarly, placement of pipelines and electrical facilities and road upgrades would result in construction activities noticeable by vehicle

occupants driving on roadways adjacent to the new facilities. Pipeline and road construction could take up to 1 year to complete. However, peak activities would be approximately 4 to 8 months. MRC WTP and Las Campanas WTP construction activities and effects would be similar to the diversion site and last for approximately 24 months and 10 months, respectively.

Operation Effects. The proposed water diversion structure would extend approximately 15 feet from the east bank into the Rio Grande. The Rio Grande at the diversion site is around 50 to 60 feet wide. Thus, the operation of a water diversion structure and associated infrastructure would be within the foreground view of river users (boaters) and site visitors and could be seen at a distance from the White Rock Overlook Park observation platform. However, the mitigation design features of the diversion structure that would incorporate the form, line, color, and texture of the riverbank environment would serve to blend it in with the surrounding river environment. After vegetation is re-established, the facility would not be readily apparent to the site visitor or viewshed observers at White Rock Overlook Park. Boaters would be aware of the structure as they proceed past, but again, due to the design, it would be compatible with the river environment and not introduce a highly discordant element into the riverscape. Both the BLM and FS would review and approve the proposed architectural design as part of the special use permit stipulations.

Booster Station 1A and the sediment facility would be apparent to the casual site user and viewed from White Rock Overlook. These facilities would be the most intrusive visual element. However, construction of these facilities at the townsite of Buckman using historical architecture that is compatible with the landscape character (form, line, color, and texture) would maintain the historical and cultural context. Project mitigation measures specify that the facilities would be designed to blend in with the landscape and history of the area. Both the BLM and FS would review and approve the proposed architectural design as part of the special use permit stipulations. Thus, these structures would be compliant with a “Moderate” FS scenic integrity management level. The design would also be consistent with BLM’s VRM Class III.

Buckman Road improvements would consist of the addition of gravel and drainage ditches, low water crossings, and realignment to improve the line-of-sight at some road bends. Surfacing with gravel would increase the reflectivity of the road and introduce a different color element to existing conditions. Buckman Road would become even more apparent to the casual viewer. As a result of the improvements, there would be moderate visual contrasts with existing landscape characteristics. In addition, because there will be necessary vegetative manipulation as part of road improvements, modifications to the landscape will be apparent, but signs of disturbance would be short duration (less than 2 years). The negative effects would be partially mitigated by use of colored additives in the concrete at all dip sections to minimize the visual contrast with the existing landscape (Figure 15). In addition, signs marking speed limit and curves would require construction in a manner compatible with the settings by constructing and finishing both signs and support posts from materials that are acceptable for a given ROS setting. Other Buckman Road improvements through Diablo Canyon would result in changes that will be noticeable to site visitors. The major changes would occur along three major curves in the Diablo Canyon area. Straightening of the road, tree removal, and roadway signage would decrease the sense of isolation experienced by the casual visitor. However, the existing landscape character would be partially retained, thus, meeting the Class III management objectives. Concrete for the low water crossing would be textured and colored to blend in with the surrounding environment, thus, moderating any visual effects to streambed crossings. The total area affected by road

improvements would be about 22 acres over about 9.2 miles of road and, for the most part, would be limited to about 10 feet on either side of the road.

Buckman Road improvements would provide easier access but, in some areas, would still present a challenge to low-clearance passenger vehicles, to a relatively scarce river use visitation point. Thus, it is reasonable to expect an increase in visitor use within the project area, but an increase that is not predictable. On public lands, this may result in more vehicles and pressures placed upon the land from various and increased recreation activities and subsequent deterioration of the viewshed. Increased vehicle traffic (vehicle movement) could substantially affect the viewshed and users' perceptions of the scenic integrity. Road improvements would be consistent with BLM's Class III/IV management objective along Buckman Road and with the FS Forest Management Plan objective of "Moderate" at the Buckman diversion site. Area L could be affected if truck traffic and visitor use increased in the area of the Buckman Project. There could be boundary deterioration between Area G and Area L with the Area L users having a reduced probability of experiencing isolation from the sights and sounds of humans.

Generally, existing utility corridors and booster station locations would be used which would serve to minimize additional effects to the scenic environment. The revegetation of construction scarred areas with plants native to the region would limit visual effects. Once plants are re-established, pipeline corridors would blend in with existing conditions. Booster station architecture that incorporates the color, form, texture and line of the surrounding landscape would serve to minimize the visual effect of additional structures. Both the BLM and FS would review and approve the proposed architectural design as part of the special use permit stipulations.

The proposed MRC WTP and associated power substation location was selected to reduce viewshed effects compared to other locations. The facilities would be designed to blend into the color, form, texture and line of the surrounding landscape. Thus, they would not be readily evident to a distant viewer after successful vegetation re-establishment. The level of change to the foreground/middle ground perspective would be moderate due to the extent and prominence of the treatment facilities and associated infrastructure. Thus, the Proposed Action would be compatible with existing site conditions and with BLM's Class III/IV management objectives. However, the proposed development is different from the City's previous concept for trails, parking, a rest area and benches. The BLM would review and approve the proposed architectural design as part of the special use permit stipulations.

Pipeline corridors on City, County, and Las Campanas lands would occur in and are compatible with a built environment. Buckman Project pipeline corridors would follow or are in existing utility corridors and/or within roadside easements.

Direct and Indirect Effects of the Sediment Facility Alternatives

The construction and operation effects are similar to the Proposed Action with the following exceptions.

Construction Effects. Alternatives SF1 and SF2 would construct Booster Station 1A and the sediment facility substantially out of the viewshed of the White Rock Overlook Park observation platform and in a location that would be much less noticeable to the Rio Grande area recreational user.

Operation Effects. Placement of the sediment and booster station facilities further southeast of the proposed location, under Alternatives SF1 and SF2, would place them substantially out of the White Rock Overlook viewshed and the facilities would not be visible to Rio Grande boaters or other visitors to the river front area. During the project design phase, if feasible, all facilities would be placed out of the White Rock Overlook viewshed. Thus, compared to the Proposed Action, effects to visual resources would be greatly reduced.

However, selection of Alternative SF2 would require trucking out sediment and would require two sediment storage ponds measuring 75 feet by 150 feet and 8 feet deep. Sediment collected for disposal would be stored and dried in these ponds. Drying sediment would be a different color than the surrounding environment and would be noticeable from some higher elevation viewing locations (i.e., Sagebrush Flats). Additional truck traffic caused by selection of SF2 (sand hauling alternative) would add to the conditions that are already unacceptable for Semi-Primitive Non-Motorized/Semi-Primitive Motorized ROS settings for the Social Encounters criterion.

Direct and Indirect Effects of the Pipeline Route Alternatives

Construction and Operation Effects. Alternative RWP1 would have construction and operation effects similar to the Proposed Action. All pipeline route alternatives would be compatible with BLM's Class III management objective; however, some would have less visual impact than others.

Alternative TWP1 would require construction and operation of the treated water pipeline in a new ROW corridor along BLM and Las Campanas lands. Approximately 17 acres would be affected by construction of Alternative TWP1. Alternative TWP2 would install the treated water pipeline back along the Dead Dog Well corridor and then cut east and would affect approximately 20 acres, some of which would be in a new ROW corridor. Alternative TWP3 would use approximately 27 acres of existing utility line ROW. Construction and establishment of a new pipeline corridor (Alternatives TWP1 and TWP2) would effect the local viewshed by introducing a straight line swathe and bare ground. Even with revegetation, the new corridor would be noticeable in the short term until vegetation is re-established. Trees would not be allowed to re-establish. However, feathering tree removal, which would be a special permit stipulation, would serve to soften the notably straight lines of the pipeline corridor. Development of a new corridor could encourage changes to and increased recreation use in the area and subsequent degradation to the natural viewshed.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. Alternative AGP1a would result in construction and operation of a substation approximately 1 mile southeast of the MRC WTP adjacent to the existing power line. This is an area where there are overhead power lines (60-foot-tall poles with high-tension wires). The substation would add another visual element in the viewshed of some houses present along Caja del Rio Road, as well as people golfing at the municipal golf course. While still compatible with a BLM's Class III management objective, the substation would degrade the viewshed along Caja del Rio Road when compared to the Proposed Action of a substation adjacent to the MRC WTP.

In Alternative AGP1b, overhead power lines from the proposed diversion intake site to Booster Station 2A would be apparent to site visitors and introduce a discordant visual element into the

river landscape. The scenic integrity would still meet the FS Scenery Management System of "Moderate." However, the FS Forest Plan specifies a "High" management value for recreation areas and water bodies. Of additional note is the adverse reaction to power lines expressed by those interviewed during the scenic resources analysis. This alternative would add to the degradation of the scenic viewshed.

Cumulative Effects

The City has drilled four new supplemental water wells on land administered by the BLM along Buckman Road. Buckman Road users are able to see all four well locations. The supplemental water wells project is additive to the construction and operation of proposed Booster Stations 2A and 3A along Buckman Road. These projects add more manmade elements into the natural environment. Construction and operation of the MRC WTP would be additive with the construction and occupation of residential housing in the surrounding viewshed. Facility and residential housing designs are sensitive to blending in with the natural landscape, however, each introduces additional manmade elements into the natural environment.

Noise

Affected Environment

The relative loudness of a sound or noise is described in units of decibels (dB), a measure of sound pressure on a logarithmic scale. Noise conditions are usually described by a time-averaged noise level, expressed as the equivalent noise level (Leq). An A-weighting filter is also used to correlate physical noise levels with the frequency sensitivity of human hearing and the subjective response to noise. Thus, noise conditions are generally discussed in terms of hourly average A-weighted noise levels in decibels (Leq dBA). The average noise level occurring over a 24-hour period is usually described as a day-night average noise level (Ldn), and includes adding 10 decibels to sound levels occurring during nighttime hours (between 10:00 p.m. and 7:00 a.m.).

Existing noise levels in the study area vary according to adjacent development and activity levels. Relatively low noise levels are experienced throughout much of the study area due to its rural character, including the vacant and undeveloped lands managed by the FS and BLM. Relatively low noise levels in these areas are attributed to light traffic on Buckman Road, recreational activities, distant aircraft, and typical natural background noises. Somewhat higher noise levels occur adjacent to Buckman Road and in the developing areas associated with Las Campanas and nearby subdivisions.

Motorized vehicles (on-road and off-road recreational vehicles) are commonly observed near the proposed diversion site, which also serves as a parking area for recreational users. Occasional use of motorized vehicles and recreational activities results in intermittent noise in the area. Several existing pump houses associated with the Buckman Well Field are also present in scattered locations throughout the study area and generate audible noise. FS property located south of the proposed diversion site, Area L, is designated for nonmotorized use. Noise levels of 65 Ldn as the upper threshold for acceptable noise levels at noise sensitive locations.

Table 21. Measured L_{eq} and estimated L_{dn} noise levels.

Description of Monitoring Location	Measured Noise Level (Leq dBA)	Estimated Day-Night Level (Ldn)
1) River – at proposed intake structure (rushing water)	54.0	60.4
2) Near River – in parking area	38.4	44.8
3) Proposed pipeline alignment – between Booster Stations 1 & 2	20.0	26.4
4) Booster Station 2 – 100 feet from pump house	51.7	58.1
5) Booster Station 2 – 1,000 feet from pump house	36.0	42.4
6) Booster Station 3 – 100 feet from pump house	53.6	60.1
7) Booster Station 3 – 500 feet from pump house	35.5	41.9
8) Booster Station 4 – 100 feet from pump house	51.9	58.3

(Source: Data obtained during project-specific noise surveys)

Noise conditions in the project area were evaluated by performing field noise measurements at several locations where noise levels may change as a consequence of the project. Noise levels were recorded at eight locations, including a site near the proposed diversion structure, along the existing pipeline alignment for the Buckman Well Field, and at several existing pump houses in the pipeline corridor. A-weighted average noise levels (Leq dBA) were collected in 10-minute intervals at each location (Table 21).

Most Federal agencies use similar criteria to evaluate noise effects and to determine the noise compatibility for different land use categories. These criteria, referred to as Land Use Compatibility Guidelines, were developed in 1980 by the Federal Interagency Committee on Urban Noise. Based on these guidelines, most agencies define residences, schools, churches, and outdoor recreation areas as sensitive to noise impacts. BLM's Farmington Field Office uses a noise standard of 48.6 dBA Leq (defined as the A-weighted noise level averaged over a 24-hour period) at a distance of 300 feet from the noise source. A review of the BLM standard indicates that the 48.6 dBA noise threshold is equivalent to the 65 Ldn dBA at a distance of 100 feet from the noise source. To simplify the discussion, the noise analysis refers to the 65 Ldn dBA noise criteria used by most Federal agencies. However, exceedences of the 65 Ldn dBA on BLM lands would also imply a noise impact according to the Farmington Field Office's standard.

Existing noise levels at the eight monitoring sites are generally well below the 65 Ldn threshold. Slightly higher noise levels were observed immediately adjacent to the existing pump houses associated with the Buckman Well Field. However, noise levels at the fence line for each of these facilities was below 65 Ldn, and noise levels were observed to rapidly diminish within a few hundred feet of each pump house.

Environmental Consequences

No Action Alternative

The No Action Alternative would not alter noise conditions in the study area. Noise levels in the recreational areas near the river would continue to be primarily influenced by recreational activities and natural noises. Noise near the existing booster station in the Buckman Well Field would remain consistent with existing noise levels. Typical neighborhood noises and traffic noise would increase in and near the developing residential subdivisions as these areas continue to develop.

Direct and Indirect Effects of the Proposed Action

Construction Effects. The project would increase noise levels in highly localized locations associated with the specific components of the diversion project. Construction activities would increase noise levels in the study area. These areas include portions of the associated pipelines along Buckman Road where trenching activities would occur and where construction vehicles would be passing as they arrive and leave the study area during the construction period. Construction activities would occur in several locations throughout the study area, including the diversion structure, sediment facility, booster stations, and WTPs. A variety of construction equipment would be used, including trenching equipment such as backhoes or excavators, loaders, graders, cranes, haul trucks, semi-trailer trucks, and cement trucks. At the diversion site, during construction, the pumps associated with the cofferdams would operate 24 hours a day, 7 days a week. However, because much of the study area is undeveloped, construction activities would generally not result in substantial noise effects.

Construction noise would be noticed in the developed areas of the Las Campanas subdivision and other developing areas along Buckman Road. Construction activities would include the use of heavy machinery to complete the trenching, pipe installation, compaction, and backfilling associated with the new water, gas, and power lines. Buckman Road would also be used as the primary route for construction equipment and hauling operations during construction. Daily truck operations during construction would average approximately 50 heavy trucks per day on Buckman Road, with peaks of over 100 trucks per day. Truck traffic would include cement trucks, semitrailers, and haul trucks. These truck operations and construction activities would produce nuisance noise for residents along Buckman Road in the Las Campanas Subdivision and could cause wildlife to temporarily vacate the immediate location. However, these operations would only occur during the construction phase of the project.

Operation Effects. Noise levels would increase slightly during operation as a result of pumping and equipment noise at booster stations and the WTPs. However, since lands near these facilities are currently vacant, and based on the type of pumping equipment that would be used and how the mechanical equipment would be housed/constructed, noise would not adversely affect adjacent land uses or populations. Predicted noise levels near each of the project facilities are also generally considered acceptable for recreational areas.

Operational noise associated with the project would consist of noise generated by the booster stations, which may operate and generate noise 24 hours per day, 365 days per year. The five new booster stations would be built in various locations in the project area. These booster stations would be similar to the existing booster stations present in the Buckman Well Field, with the

pumping equipment enclosed in roofed structures constructed with concrete masonry blocks. Because the future booster stations would have pumping equipment and masonry enclosures similar to those used at the existing stations, noise generated from pumps at the new booster stations is expected to be similar to noise levels generated by the existing booster stations. This assumption is used as a basis for predicting future noise levels associated with the proposed booster station sites.

The potential for noise emanating from the diversion pumps would be virtually nonexistent. The pumps would be of the canned submersible vertical turbine type, wherein the motor and rotating impeller elements would be totally submerged and entirely enclosed within a steel can some 20 feet below the ground level. The top of the pump cans would be located within a buried concrete vault and connected directly to buried discharge piping a minimum of 4 feet below ground.

The booster stations would be constructed alongside two existing booster stations (Booster Stations 2A and 3A) and at three locations where no pumps are currently present (Booster Stations 1A, 4A and 5A). For the purposes of a conservative analysis, each future pump station was assumed to generate the equivalent of two of the existing stations. Future noise levels near each booster station were estimated using logarithmic addition, wherein a doubling of sound energy produces an increase of 3 decibels. Noise levels at different distances were estimated using the principle of simple attenuation from a point source (noise attenuation is expressed as a function of 20 times the logarithm of the reference distance divided by the distance to the receiver). Table 22 provides the estimated average noise levels (L_{eq}) and day-night average noise levels (L_{dn}) at various distances from the proposed booster stations and the diversion structure.

Table 22. Estimated noise levels at various distances from future booster facilities (L_{dn}).

Distance From Booster Stations	L_{eq} dBA	L_{dn}
100 feet	56.6	63.1
500 feet	42.6	49.1
1,320 feet (1/4 mile)	34.2	40.6

(Source: Data obtained during project-specific noise surveys)

As shown in Table 22, noise levels at the proposed booster stations (with dual pump houses) would be approximately 56.6 decibels (63.1 Ldn) at a distance of 100 feet. This 100-foot distance generally corresponds to the distance between the existing booster stations and the fenced enclosure surrounding each of the facilities. Therefore, noise levels at the fence line of the future booster stations are expected to remain below 65 Ldn, and not exceed the upper noise threshold established by most Federal agencies for noise sensitive locations, such as residences, schools, churches, and outdoor recreation areas. While compatible with current and future land uses, faint noise from the booster stations may be audible in some areas (as far as a quarter mile away) where current noise levels are very low (in the low 30 decibel range).

Direct and Indirect Effects of the Sediment Facility Alternatives

Construction Effects. Construction noise associated with the various sediment facility alternatives is expected to be similar to the Proposed Action, but would vary by location. Because both of these potential sediment facility sites are located in undeveloped areas, construction activities would not affect any noise sensitive locations. Since construction equipment and construction vehicles would access the sediment facility sites via the same route, Buckman Road,

Alternative SF1 is not expected to produce different noise effects in existing residential areas during the construction period.

The location of Alternative SF2 would be the same as Alternative SF1 and, therefore, effects from construction of the facility itself would be the same as Alternative SF1 and the Proposed Action.

Operation Effects. Operation of the various sediment alternatives would be similar, with the exception of the SF2 Alternative. The Proposed Action and Alternative SF1 would return sand collected by the sediment facility back to the river. Alternative SF1 and SF2 would locate the sediment facility and booster station further away from the river, thereby reducing the level of noise at the river. Alternative SF2 would retain sand accumulated with the diverted river water at the sediment facility site. This alternative would require stockpiling the accumulated sand and periodically loading the sand on trucks and hauling it away from the facility site. It is anticipated that loading and hauling the sand would occur intermittently and require up to 1,000 truck trips per year. Haul trucks used for this purpose would likely use Buckman Road to transport the sand to either the Caja del Rio Landfill or to local sand and gravel operators. Therefore, compared to the other action alternatives, Alternative SF2 would result in more truck traffic noise periodically to residents along Buckman Road and more noise during removal of sand from the sediment facility.

Direct and Indirect Effects of the Pipeline Route Alternatives

Construction Effects. Construction of the various pipeline routes would involve trenching, pipe installation, compaction, and backfilling associated with the new pipelines. Noise effects from the alternatives would be less than the Proposed Action since the route under the Proposed Action is much closer to the Las Campanas Subdivision. These trenching and pipeline installation activities may result in short-term nuisance noise in some areas, but they would be transient in nature and end when construction was complete.

Operation Effects. Once the pipeline system is installed, it would not produce noise regardless of its location. Therefore, none of the pipeline alternatives would result in operational noise effects.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. Alternative AGP1 effects would be similar to the Proposed Action for the power upgrade.

Cumulative Effects

Ambient noise levels would increase area wide as the Las Campanas Subdivision and nearby areas continue to develop with residential uses. This residential development would increase land use intensity and produce additional traffic in the area. Noise associated from the additional development is expected to outweigh noise from the project facilities. However, the future noise environment and cumulative noise effects are expected to be typical for residential areas.

Air Quality

Affected Environment

The Federal Clean Air Act of 1970 and its amendments established National Ambient Air Quality Standards (NAAQS) to protect the public from harmful levels of common pollutants in ambient air. The NAAQS establish maximum allowable concentrations for six major air pollutants: carbon monoxide (CO), sulfur dioxide (SO2), nitrogen dioxide (NO2), ozone (O3), lead (Pb) and particulate matter (PM).

The New Mexico Environment Department (NMED) Air Quality Bureau (AQB) operates three permanent air quality monitors in Santa Fe: one near Cerrillos Road, one near St. Francis Drive and one near Old Pecos Trail. No exceedences of ambient air quality standards have been recorded at these monitors, and the County is currently classified by EPA as being in attainment of all Federal ambient air quality standards.

No major stationary or mobile sources of air pollutants occur within or adjacent to the project area. Limited traffic volumes on Buckman Road and adjacent roadways are insufficient to generate substantial concentrations of mobile-source pollutants. According to the AQB, current well sites in the Buckman Well Field operate with natural gas combustion engines. However, these small booster stations do not generate sufficient emissions to require individual air quality permitting by AQB. Because of the area's generally low development levels and the lack of major emission sources, high pollutant concentrations do not occur in the study area.

Environmental Consequences

No Action Alternative

The No Action Alternative would not affect air quality in the study area. Air quality conditions would be influenced by small emission sources in the area, including local roadways and activities associated with the area's development (e.g., residential wood burning). Air quality emissions would be expected to increase somewhat as the Las Campanas Subdivision continues to develop. However, based on the rural nature of the project area and the absence of major pollutant sources in the area, high pollutant concentrations are not expected.

Direct and Indirect Effects of the Proposed Action

Construction Effects. Minor temporary air quality effects would occur as a result of construction activities, including dust from earthwork and emissions from heavy construction equipment. These effects would be minimized by requiring contractors to be responsible for dust and sediment control. Dust control would involve the application of dust suppressants where appropriate, covering haul trucks, and limiting disturbance to only areas that are necessary. Temporary and permanent fencing would be used in some areas to limit construction disturbance and silt fences would be installed for sediment control. Additionally, the contractor would be responsible for ensuring that all construction equipment meets Federal emissions standards.

Operation Effects. Proposed Buckman Road improvements to add subbase and surface gravel would serve to reduce dust generated during vehicle passage. The additional booster stations for the project would operate using natural gas combustion engines. Based on the limited scale of the

pumping equipment proposed for the project, air quality effects would not occur. As the project proceeds into its design stages, additional consultation would occur with the NMED to determine if air quality permits would be required. This additional review and permitting process would ensure that substantial pollutant concentrations would not occur as a consequence of the project.

It is estimated that the pumping equipment to be used at the diversion structure and at the booster stations would operate similarly to those currently present in the Buckman Well Field. According to the NMED AQB, emissions from these facilities do not exceed thresholds that require air quality permitting. Therefore, pollutant concentrations attributed to these facilities are expected to remain well below NAAQS in the vicinity of each booster station. However, as part of final design for the project, the AQB would be consulted (via a preapplication meeting) to determine if the additional booster stations would exceed emissions thresholds for facilities that require permitting. This process would ensure that air quality effects would not occur and that exceedences of Federal ambient air quality standards would not occur in the study area.

Direct and Indirect Effects of the Sediment Facility Alternatives

Construction Effects. Construction effects of Alternative SF1 are expected to be similar to the Proposed Action but would vary by location. Because the alternative sediment facility site is located in an undeveloped area, construction activities at the alternative site would not affect any populated areas. Since construction equipment and construction vehicles would access the sediment facility site via the same route as the Proposed Action, Buckman Road, Alternative SF1 is not expected to produce different nuisance dust and exhaust emissions in existing residential areas associated with the Las Campanas Subdivision during the construction period.

The location of Alternative SF2 would be the same as Alternative SF1 and, therefore, effects from construction of the facility itself would be the same as Alternative SF1 and the Proposed Action. Minor temporary air quality effects, including dust from earthwork and emissions from heavy construction equipment, would be minimized by requiring contractors to be responsible for dust and sediment control. Dust control would involve the application of dust suppressants where appropriate, covering haul trucks, and limiting disturbance to only areas that are necessary. Temporary and permanent fencing would be used in some areas to limit construction disturbance and silt fences would be installed for sediment control. Additionally, the contractor would be responsible for ensuring that all construction equipment meets Federal emissions standards.

Operation Effects. Operation of Alternative SF1 would not produce additional air quality emissions. The effects would be very similar to the Proposed Action, but would vary by location, with the exception of Alternative SF2. The Proposed Action and Alternative SF1 would return sand collected from the intake structure back to the river. Alternative SF2 would retain sand at the sediment facility site. This alternative would require stockpiling the accumulated sand and periodically loading the sand on trucks and hauling it away from the facility site. It is anticipated that loading and hauling the sand would occur intermittently and require up to 1,000 truck operations per year. Haul trucks used for this purpose would likely use Buckman Road to transport the sand to either a landfill or to local sand and gravel operators. Therefore, compared to the other action alternatives, Alternative SF2 would result in more truck traffic on Buckman Road. These operations would potentially cause periodic nuisance dust and exhaust emissions to residents along Buckman Road, and would not be expected to exceed any NAAQS standards. Improvements (gravel) to Buckman Road would serve to minimize dust generation.

Direct and Indirect Effects of the Pipeline Route Alternatives

Construction Effects. Construction of the various pipeline routes would involve trenching, pipe installation, compaction, and backfilling associated with the new water lines. These activities would result in temporary increases in nuisance dust and vehicle exhaust emission during construction. Air quality effects from the alternatives would be less than the Proposed Action since the route under the Proposed Action is much closer to the Las Campanas Subdivision. These trenching and pipeline installation activities may result in short-term nuisance air emissions in some areas, but they would be transient in nature and end when construction was complete.

Operation Effects. Once the pipeline system is installed, it would not produce air quality emissions regardless of its location. Therefore, none of the pipeline alternatives would result in operational air quality effects.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. Alternative AGP1 effects would be similar to the Proposed Action for the power upgrade.

Cumulative Effects

Pollutant emissions would increase area wide as the Las Campanas Subdivision and nearby areas continue to develop with residential uses. This residential development would increase land use intensity and produce additional traffic in the area. Emissions associated with the additional development are expected to outweigh any emissions from project facilities. However, based on the limited density of development proposed for the area and the absence of major pollutant sources, cumulative air quality emissions would not produce exceedences of Federal ambient air quality standards or threaten the air quality status of the area.

Geology and Soils

Affected Environment

The Buckman area is dominated by quaternary alluvium that has been deposited by the Rio Grande and the ephemeral Cañada Ancha (Balleau 1995). Igneous rocks of the area can be segregated into Tertiary and Quaternary extrusives of the Jemez Mountains (BOR/City of Albuquerque 2002).

The alluvium is underlain by the Tesuque Formation of the Santa Fe Group, which consists of many thousands of feet of Tertiary basin-fill sandstone with interbedded siltstone and claystones. The Tesuque Formation is an important regional aquifer throughout much of northern Santa Fe County, and the City has completed nine deep production wells in the Tesuque Formation in the Buckman area since 1972 (Balleau 1995).

The project area is within the Española Basin. The Pojoaque and Puye fault zones, minor fault zones closest to the project area, run generally north-south in the Española Basin. Seismic activity was present during the Tertiary period, as evidenced by faulting in the area; however, there has been no displacement of these faults during the last 10,000 years. However, a fault structure discovered recently in the Buckman Well Field area was likely reactivated along a previous fault

zone and may have been caused by the withdrawal of water from aquifer storage in the Buckman area.

At no point does the project area enter lands directly adjacent to and beneath the talus slope flanking the rim of Caja del Rio Plateau.

There is no mining within or adjacent to the project area for leasable or locatable minerals.

The entire project area is within the Western Soil Region, one of six major soil regions in New Mexico. Soils on the steeper slopes are generally shallow, moderately fine textured, and contain a high percentage of coarse fragments. Mesa tops, plateaus, and lava flows have soils that are shallow to moderately deep, and moderately coarse to medium textured. Cobbles and stones are common to soils developing on flood plains of the Rio Grande and Cañada Ancha (BLM 1988).

Soils along the Buckman and Dead Dog Leg corridors generally have a thin, sandy clay loam A horizon and a gravelly, sandy clay loam C horizon that grades into a sandy, gravelly parent material with depth. In general, the soils are poorly developed on the ridges and show more development on the flat areas (BLM 1972).

Productivity of soils within the project area are relatively low, supporting a community of piñon-juniper savannah. Interspersed between the trees are drought tolerant grasses, shrubs, and forbs as well as several cactus species. Historically and presently, livestock grazing activities occur along the corridor resulting in obvious signs of disturbance, and very little grass is left at the most highly impacted sites. Where most of the grasses have been removed, signs of erosion are present. The soils in the project area have moderate to high erosion potentials. While much of the project area is on relatively flat to slightly rolling terrain, evidence of erosion is present at select locations. Much of the runoff in the area is in the form of sheetwash that becomes channelized as it meets the Cañada Ancha. In previously disturbed locations with greater slope, erosion is generally problematic and rill and gullies are present. In areas where vegetative stabilization has been greatly impacted or removed by livestock, past construction, rock fall, recreation activities, or other disturbances, intensified erosion prevails.

Due to the relatively abundant coarse material and sands in the soils throughout the project area, compaction tends to be relatively low. The sandy soils are well drained and tend to dry quickly after a precipitation event, which in turn limits soil compaction from overburdened sources. However, road grading practices and unrestricted use of Buckman Road during wet weather has resulted in an incised—in some places over 2 feet below the surrounding topography—roadbed characterized by washboarding and poor drainage conditions. Overland sheet flow is intercepted by Buckman Road and channelized into the roadside drainage ditches. This condition has resulted in altered watershed drainage patterns and decreased water availability in some areas downslope of Buckman Road. Runoff from damaged road surfaces is at a higher velocity than the normal overland sheet flow. Therefore, roadway drainage waters have a greater erosion potential and capability of carrying a higher sediment load that is deposited in surrounding streambeds and ultimately transported to the Rio Grande. Interception of overland flow by Buckman Road also results in reduced infiltration, thus contributing to additional surface runoff.

Environmental Consequences

No Action Alternative

If the No Action Alternative is selected, construction and operation of the diversion structure and associated infrastructure would not occur. No short- or long-term direct or indirect effects to geology or soils resources would result due to implementation of the No Action Alternative.

Direct and Indirect Effects of the Proposed Action

Implementation of soil erosion mitigation measures coupled with the revegetation program would prevent adverse effects to soil resources.

Construction Effects. Best management practices would be employed by construction contractors to minimize project-related effects. Construction activities that require ground disturbance would cause minimal increases in erosion because of the implementation of erosion control measures (i.e. silt fencing, gabion mats, etc.). Mitigation measures would reduce the loss of soil, prevent the establishment or exacerbation of rill and gullies, and minimize water quality deterioration that would be associated with construction and roadway use by project vehicles. Erosion control measures would be designed in compliance with the requirements for preparation of a storm water pollution prevention plan to mitigate negative effects.

Operation Effects. Buckman Road improvements would result in better distribution of storm water and decreased erosion that could result in minor watershed benefits. Implementation of a revegetation program (biological resources mitigation) that would result in the mulching of construction scarred areas coupled with the re-establishment of plant cover would provide a level of protection against wind and waterborne soil erosion. This project requirement would further mitigate effects to soil resources for the duration of the project.

Direct and Indirect Effects of the Sediment Facility Alternatives

Construction and Operation Effects. Specific effects to soil resources are expected to be the same as for the Proposed Action.

Direct and Indirect Effects of the Pipeline Route Alternatives

Construction and Operation Effects. Specific effects to soil resources are expected to be the same as for the Proposed Action.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. Alternative AGP1 effects would be similar to the Proposed Action for the power upgrade.

Cumulative Effects

No specific geology and soils resources cumulative effects have been identified.

Social and Economic Resources

Affected Environment

Population and Housing, Growth and Dynamics

The area of potential effect includes the City of Santa Fe, Santa Fe County, and Las Campanas. The total population for Santa Fe County, as enumerated by the 2000 U.S. Census, was 129,292. As can be seen in Table 23, almost 81 percent of that total live in the central region of the County, 62 percent live in the Santa Fe urban area, and 48 percent, or 62,203 people, live within the City of Santa Fe. The County is growing faster (30.7 percent) than the State of New Mexico (20.1 percent between 1990-2000). The County is also growing faster than the City, continuing a trend first seen in 1980, when 65 percent of the County population lived within the City limits. In 1990, 57 percent of the County population lived within the City limits.

Table 23. Santa Fe County and sub-area population, 1990 and 2000.

Area	1990	2000	Percent of County 2000	Change 1990-2000 Number (percent)
Santa Fe County	98,928	129,292	100.0%	30,364 (30.7%)
Central Region	81,451	104,601	80.9	23,150 (28.4%)
Total Urban Area	66,541	79,545	61.5	13,004 (19.5%)
City of Santa Fe	55,859	62,203	48.1	6,344 (11.4%)

(Source: UNM 2002)

Almost half (49 percent) of the County's population reports themselves as being of Hispanic or Latino origin; 45.5 percent reported as white persons, not of Hispanic or Latino origin; and 3.1 percent reported as American Indian and Alaska Native persons. Santa Fe County is also multilingual; only 63 percent of residents reporting on the 2000 U.S. Census speak only English in the home.

Over 50 percent of the population 15 years and older were married when the 2000 U.S. Census was conducted. Almost 30 percent of the residents report having never been married. Females account for approximately 51 percent of the population of Santa Fe County; almost 25 percent of families have a female head of household with no husband present. The median age in Santa Fe County is 37.9 years, reflecting the nationwide trend of an aging population.

According to the 2000 U.S. Census, 23,538 children were enrolled in kindergarten through high school in Santa Fe County in April 2000. Almost 8,300 people were enrolled in junior college, college, or graduate school. Of the population over age 25, 84.5 percent have a high school diploma or better; almost 37 percent have a bachelor's degree or more college education.

More housing is being built outside the City limits, and the City is permitting fewer residential units—510 per year during the 1992-2001 period, down from an average of 687 units in the previous 10 years (UNM 2002) or a 35 percent decrease in the 10-year period. Reasons for this include the higher price of land and the requirement to hook up to municipal services in the City limits. Average population per household in Santa Fe County is 2.42 people; the Santa Fe Northwest Community Plan estimates that household size in the Las Campanas area is much lower, conservatively estimated at 2 people for full-time residents (SNAC 1999).

According to the U.S. Census, the median value of Santa Fe County owner-occupied housing units in 2000 was $189,400. Many of the most expensive homes in the County do not meet the census definition of owner-occupied, being second or seasonal homes for people who are legal residents of another state. This skews the median value presented in the census downward from Board of Realtor statistics, which includes all existing and new single-family detached homes. During the second quarter of 2000, which includes the day the census is taken, the board reports that the median home sales price in Santa Fe County was $250,000; in the north section of the County, the median price was $540,250 during the same reporting period (MLS 2000). During the last quarter of 2002, the last full reporting period, median price of a house County wide was $276,000, while the median sales price of a house in the north section of the County was $535,000 (MLS 2002).

Las Campanas, a private community 6 miles northwest of Santa Fe in Santa Fe County, currently has approximately 410 houses built and occupied and has plans for a total of 1,700 houses at full build-out. Estate sites at Las Campanas range from less than 1 acre to more than 5 acres in size and begin at $250,000 up to $1.5 million. Smaller home sites designed for semicustom houses are priced lower. Homes range between $950,000 and $2.5 million depending on size and location.

Another important aspect of the housing sector is the rental market because it can indicate problems for lower income and/or younger residents who are not able to qualify for homeownership. The number of rental units appears to have remained stable during the past 10 years although the demand (vacancy rate) has increased, as have the median rents. (Table 24)

Table 24. Rental units, Santa Fe County.

	1990	2000
Number of total occupied units	37,840	52,482
Number of rental-occupied units	12,219	16,497
Percent of total occupied housing units	32.2%	31.4%
Percent of vacancy rate	7.1%	5.6%
Median rent	$425	$690

(Source: Census Bureau 1990; Census Bureau 2000a)

Tables 25 and 26 summarize the population and housing projections based on no water shortages, an unlikely scenario even with the completion of the Proposed Action. The Bureau of Business and Economic Research (BBER) at the University of New Mexico projects that the population of Santa Fe County would increase to 158,624 people by 2010 (UNM 2002). Based on the decreasing percentage of County residents living within the City limits, approximately 63,450 people would live in the City of Santa Fe at that time.

Table 25. Population projections, 2010.

Area	2000 Population*	Percent Growth 1990-2000*	Projected Population 2010	Percent Growth 2000-2010
Santa Fe County	129,292	30.7	158,624	22.7
Central Region	105,272	28.4	128,518	22.1
Total Urban Area	80,056	19.5	89,734	12.1
City of Santa Fe	62,203	11.4	63,450	2.0
Las Campanas	800	-	2,400	

(Source: *Census Bureau 2000a; UNM 2002)

Table 26. Housing projections, 2010.

Area	2000 Housing Units*	Projected New Units 2010	Projected Total Housing Units
Santa Fe County	57,701	6,650**	64,351
City of Santa Fe	30,533	4,000**	34,533
Las Campanas	400	700***	1,700 (2015)***

(Source: *Census Bureau 2000a; **UNM 2002; ***CH2M Hill 2001)

Growth in the housing stock would grow along similar lines with the majority of the new housing being built outside the City limits.

Ways of Life

Founded in 1607, Santa Fe is the second oldest city in the United States and is the oldest capital city in America. Tourists coming to Santa Fe for its art galleries and museums, fine restaurants, and cultural attractions such as the renowned Santa Fe Opera are also interested in the possibility of visiting nearby Indian pueblos such as Tesuque and traditional Hispanic villages such as La Cienega.

Historically, this part of northern New Mexico is characterized by the rural and agricultural nature, Indian and Hispano populations, and pockets of persistent poverty (Jemez y Sangre 2002). The current tricultural mix of Anglo, Hispanic, and Indian populations represents a unique culture in the world. Land based Indian and Hispano cultures continue the centuries-old traditions that included distinctive land use and settlement patterns, agricultural and irrigation practices, natural resource stewardship practices, social relations, religious activities, and architecture. Many of these traditions and practices are being lost because these same tourists are now settling in the area, changing the demographic and income structure of the communities.

Residents of northern New Mexico have a special relationship with water, characterized by a popular bumper sticker, “Agua es vida.” Traditional acequias still run through the City during the summer, and there are irrigation ditch associations all over the County. Santa Fe residents, customers of Sangre de Cristo Water, have been under mandatory Stage 3 Water Shortage Emergency Use restrictions since April 2002. Under the Stage 3 restriction, vehicle washing is restricted to once a month and outdoor watering is restricted to once a week with no planting of new grass seed or sod allowed. The use of ornamental fountains is prohibited. Tourist services are also restricted: linens may not be changed more than once every 4 days for guests staying more than 1 night, and restaurants may serve water only upon request. Drought emergency surcharges and water use violation fees are in effect for both residential and commercial customers.

The Santa Fe City Council passed an Annual Water Budget Ordinance in late 2002, which requires all permit applications for construction of new homes or businesses to be accompanied by payment for retrofitting a sufficient number of water conserving fixtures in other existing residences or businesses to fully offset the anticipated increase in water use. Alternately, applicants may directly install these fixtures.

Santa Fe County Commissioners adopted a voluntary water conservation plan in July 2000 and water use restrictions in August 2000, that authorize the County water utility to impose the same

level of restrictions and penalties on its customers as those in force in the City. The County water utility is directly connected to the City's water supply and system and directly impacted by any water shortages the City may experience. Commissioners recently adopted an ordinance that includes significant landscaping restrictions directed toward water conservation and is developing a comprehensive mandatory conservation program for the entire County.

The Las Campanas Master Design Guidelines contain a policy designed to conserve water consumption. Estates 1 and 2 of the development are on City water; in other sections, water use is restricted to 0.25 acre-feet per year for lots with one home and to 0.5 acre-feet per year for lots with a home and a guesthouse. Lot owners who install swimming pools are required to obtain additional water rights. The design guidelines require the use of water-saving fixtures and limit landscaping to drought tolerant indigenous plant materials. The golf courses are primarily irrigated with recycled gray water.

Community Services

The City provides a full range of community services to its residents, including municipal utilities such as water and waste water services and garbage pickup and landfilling. In addition, community services such as fire, police, and emergency services are provided, as well as recreational and educational opportunities. The County provides community services such as fire, police, and emergency services. It provides water and wastewater services for some areas. Solid waste pickup is available from private hauling companies and most County residents use septic tanks and leach fields for liquid waste disposal. Roads are maintained by County crews.

Most of the land surrounding the project area is vacant and owned by either the FS or BLM. A number of subdivision and planned developments are located along Camino la Tierra, which becomes Buckman Road at the northwest corner of Las Campanas. Electrical power is provided by above ground lines and buried cables. Telephone lines are extended as development occurs. There are few community services in the project area. With the exception of City water at some of the close-in subdivisions, residences rely on wells. Solid waste pickup is available from private hauling companies. Most of the communities use septic tanks and leach fields for liquid waste disposal (SNAC 1999). There are no schools or developed recreation areas. Several of the planned developments have community centers for their residents with meeting rooms, swimming pools, tennis courts, and spas. Las Campanas has two private 18-hole golf courses. Emergency medical and fire services are provided by County and volunteer department personnel. Police protection is provided by private security forces, the County Sheriff's Office, Federal law enforcement personnel, and the New Mexico State Police.

Revenue Base

During the 1990s, the taxable gross receipts for the County increased 93 percent for a compound annual rate of 6.8 percent. The City's gross receipts tax base grew by 80 percent or a compound rate of 6 percent. Given that employment grew more in the City than in the County, this appears to be unreasonable until the impact of a new law requiring gross receipts taxes on housing sales to be reported at the location of the house rather than the location of the real estate agent's office is factored into the equation. By 2000, the City's share of the County total had slipped below 80 percent and was just over 78 percent in 2001, a bad year for Santa Fe and other tourist destinations. While Santa Fe has maintained its share of total taxable gross receipts from retail

trade and services, it accounts for only about half of the total taxable gross receipts from construction.

Total taxable gross receipts for the County in 2001 was $3,101.5 million, dominated by retail trade ($1,289.2 million) and services ($869.9 million), both major components reflecting the importance of the tourist industry.

Employment/Unemployment

Employment in the County has grown by almost 30 percent over the past 10 years, similar to the population growth rate. Unlike population growth, which grew faster in the County, job growth continues to be concentrated in the City. As shown in Table 27, the top employment sectors are the services industry (30 percent), government (28 percent), and retail trade (14 percent). Combining the individual components in another way, employment related to tourism (including retail trade; arts, entertainment, and recreation; and accommodations and food service) is almost 30 percent. Construction employment accounted for almost 8 percent of total County employment in 2001.

The decreasing share of employees in the agriculture, forestry, fishing, and hunting category is an indication of change in the County; the category now reflects subsistence activities rather than full-time work. In the 1990 U.S. Census, 889 persons were employed in this category; the 2001 estimates gathered by the New Mexico Department of Labor list only 194 persons in this category, a 78 percent decrease. This decrease in employment is especially noticeable in the central region of the County where small farms and ranches are being developed into home sites. The majority of employment now seen in this category is on the few remaining large ranches in the eastern County area, south of Galisteo and north of Interstate 40.

Table 27. Total employment and annual average wages, by industry, Santa Fe County, 2001.

Industry	Total Employed	Average Annual Wages
Agriculture, forestry, fishing, and hunting	194	$23,816
Mining	161	$40,664
Utilities	126	$38,272
Construction	4,624	$29,380
Manufacturing	1,402	$26,052
Basic Industry - Subtotal/Percentage of Total Wholesale Trade	**6,507/11.1%**	
Wholesale trade	850	$37,856
Retail trade	8,416	$24,492
Transportation and warehousing	514	$26,520
Trade - Subtotal/Percentage of Total	**9,780/16.6%**	
Information	969	$37,960
Finance and insurance	1,530	$43,888
Real estate, rental and leasing	1,081	$29,900
FIRE – Subtotal/Percentage of Total	**3,580/6.1%**	

Industry	Total Employed	Average Annual Wages
Professional and technical services	2,617	$47,684
Management of companies and enterprises	207	$29,536
Administrative and waste services	1,751	$22,412
Professional and Managerial - Subtotal/Percentage of Total	**4,575/7.8%**	
Educational services	1,224	$27,820
Health care and social services	5,198	$33,540
Arts, entertainment and recreation	1,197	$24,544
Accommodations and food service	7,948	$15,860
Other services, except public administration	2,274	$23,972
Services – Subtotal/Percentage of Total	**17,841/30.4%**	
Federal government	1,389	$44,980
State government	9,332	$32,188
Local government	5,729	$23,192
Government – Subtotal/Percentage of Total	**16,450/28.0%**	
Non-classifiables	32	$33,488
TOTAL	**58,765/100%**	

Nonagricultural employment in the County has increased at a faster rate than both the State and the Nation since 1960. The BBER estimates that employment growth would decline from 4 percent to 2.2 percent during the next 8 years. Growth would primarily occur in the retail trade and services sectors, reflecting the continuing importance of tourism to the City's economic structure (UNM 2002). In 2001, the unemployment rate for the County was 2.6 percent and 2.4 percent for the City.

Income

Income statistics for the County reflect significantly higher median household and per capita incomes than for New Mexico residents as a whole. Median household for 1999, as presented in the 2000 U.S. Census, is $42,207 for the County and $34,133 for the State. Per capita income for County residents was reported at $23,594 compared to $17,261 for the State average (Census Bureau 2000a). UNM 2002 reports that wage and salary disbursements account for only 43 percent of the County's personal income in 1999, compared to 58 percent nationwide. Income in the County is supplemented by dividends, interest, and rent (27 percent) and owners income (10 percent). Even though the County per capita income is above the national average, the average wage in the County is only about 80 percent of the U.S. average (UNM 2002).

Economic Forecast

If growth in the area was unconstrained, the BBER estimates that employment would grow at a compound annual rate of 2.2 percent, primarily in the retail trade and services sector maintaining the area's dependence on tourism into 2010 (UNM 2002). Employment growth would create a

demand for over 3 million square feet within the City, while the gross receipts tax base, as estimated, would grow at a compound annual rate of 4.2 percent.

Environmental Consequences

Under all alternatives, growth would be constrained because water is the limiting resource (UNM 2002). Water shortages would continue unless the climate changes and drought conditions lift.

No Action Alternative

Under the No Action Alternative, population and housing growth in the County would gradually decrease as fewer new housing units would be permitted and built. Subdivisions with already approved units would be more likely to be built, but fewer than 3,150 units would be able to obtain utility hookups during the 10-year planning period (UNM 2002), thereby reducing the amount of population growth and potentially increasing the per unit cost of both owner-occupied and renter-occupied units based on supply/demand dynamics (UNM 2002). Subdivided land would remain undeveloped and would remain vacant rather than reverting to a previous land use such as agricultural. Development of additional units at Las Campanas would be restricted. If the water shortage were to reach Stage 4 water restrictions, the BBER predicts that new building activity in the County could shut down (UNM 2002), although builders are not expected to abandon the area but rather wait until the water situation is resolved and housing development can resume.

Ways of life for local residents would be affected if Stage 4 and 5 water restrictions were imposed if severe drought conditions persist. These restrictions would severely curtail the traditional landscaping that accompanies the architecture in the historic district of the City. Tourism would gradually decrease, as the traditional landscape cannot be watered, although water shortages would not affect the art and other historical attractions that draw visitors. Tourism may be indirectly affected because Stage 3 water restrictions limit amenities at restaurants and hotels. Those limitations would increase if Stage 4 or 5 restrictions became necessary.

The severely limited water scenario would have several direct effects on the Santa Fe economy. Constraints on commercial development would be experienced, but there is much commercial space currently vacant or underutilized that would accommodate any growth in this sector (UNM 2002). The effects of the water shortage would be felt in 2006 and beyond.

BBER estimated that slower growth due to water shortages would result in gross receipts tax revenues averaging 3.45 percent for 2003 through 2010, compared to the City's compound annual average of 6 percent during the 1990s. Because community services and facilities are operated using these gross receipts tax revenues, services would have to be curtailed (UNM 2002). BBER explored the relationship between gross receipts taxes and housing development and reports that many municipalities are in a sense addicted to growth because up to 70 percent of their general fund revenues are from gross receipts taxes on housing construction (UNM 2002). As housing starts decrease, so do gross receipts tax revenues.

Retail and services employment would also be affected as opportunities for new businesses decrease. The construction sector—currently at almost 8 percent of the total labor market—would be directly impacted if new residential and commercial building activity is restricted by water shortages. The BBER estimates that building construction employment would fall by roughly 10

percent by 2005, possibly affecting up to 500 workers in the area (UNM 2002) or almost 1 percent of the existing labor force. Under the No Action Alternative, no project construction, operation, and maintenance jobs would be created to offset the lost jobs.

Direct and Indirect Effects of the Proposed Action

Under the Proposed Action, which includes the delivery of 8,730 acre-feet of water per year through the diversion, growth would be moderately to tightly limited because of water availability. The BBER estimates that housing unit building permits would be restricted to between 5,656 (moderate limits) to 3,132 (tight limits) during the 10-year planning period (UNM 2002), well short of the estimated 9,143 units predicted for the central region of the County under an unconstrained, no water shortage scenario. Again, using the concept of supply and demand, as the number of houses constructed is decreased, the cost of each dwelling unit would increase. Although development of additional units at Las Campanas would be restricted up to 2006, full build-out would be achieved by 2015 as planned (CH2M Hill 2001).

This amount of water to be delivered via the diversion is not sufficient to ease all of the water demand pressures in the region, so the effects to ways of life, tourism, and commercial development would be similar to the No Action Alternative although the imposition of Stage 3 water restrictions during peak demand periods would be shorter or potentially avoided altogether. Stage 4 and 5 water restrictions would be avoided for the near-term foreseeable future.

BBER estimated that the slower growth due to less water availability would result in gross receipts tax revenues averaging 4.2 percent per year for 2003 through 2010, compared to the City's compound average of 6 percent during the 1990s. The BBER predicts that the construction sector of the labor force would initially feel the same range of effects as under the No Action Alternative even though more houses would be permitted (UNM 2002). As housing starts decrease, so do gross receipts tax revenues. Local governments would continue to be financially stressed to provide the current range of community services.

Construction Effects. Construction of the diversion project would employ 220 workers during the peak construction phase, effectively offsetting almost 50 percent of the construction workers laid off from other building. Table 1 lists the construction schedule and workforce requirements for the Proposed Action. Construction of the Proposed Action is scheduled to take 24 months with an average employment of 25 workers. As shown in Table 27, wages for construction workers in the County averaged $29,380 per year in 2001 (UNM 2002). The Proposed Action would generate a minimum of $1,469,000 in wages. Peak employment is expected to reach 220 workers for the project as a whole and to last 18 months placing the upper range of wages income at $9,792,000. The total project cost is estimated at approximately $60 million; in addition to wages, construction materials and supplies would be purchased from local suppliers out of that total. Dollars that come into a community from new wages also help create other new jobs because of the purchase of personal items such as food, gas, housing, utilities, medical services, and other items. This is called the multiplier effect, and because the direct dollars come from local sources, the multiplier is 1. For every dollar paid in wages, another dollar would be generated from other businesses. The 2-year economic benefit from construction of the Proposed Action is between $2,938,000 and $19,584,000 to the local economy.

Operation Effects. Operation and maintenance of the facilities would be done by Sangre de Cristo crews and would require approximately 16 new employees depending on the operations

and maintenance schedules required. Salaries for operations and maintenance workers range between $9.47 and $16.39/hour. Assuming an equal number of entry level and skilled workers, an average wage would be $12.93/hour or $26,894 per year. Operation and maintenance of the facilities would generate an additional $430,304 each year after construction is complete. With the 1:1 multiplier, another $430,304 would be contributed to the local economy each year.

Direct and Indirect Effects of the Sediment Facility Alternatives

Effects to all aspects of the social and economic environments, under any of the alternatives' construction or operation, are expected to be the same as for the Proposed Action.

Direct and Indirect Effects of the Pipeline Route Alternatives

Effects to all aspects of the social and economic environments, under any of the alternatives' construction or operation, are expected to be the same as for the Proposed Action.

Direct and Indirect Effects of the Power Upgrade Alternative

Construction and Operation Effects. Alternative AGP1 effects would be similar to the Proposed Action for the power upgrade.

Cumulative Effects

The ability to sustain growth is influenced by many factors (UNM 2002). Assured water availability is arguably the most influential factor governing growth in the County region. Present and reasonably foreseeable activities that affect growth in the region are all overshadowed by the availability of water. The Buckman Supplemental Wells Project provides a source of water to the City and County, but short-term supply would be seriously impacted if the San Juan-Chama Project water is not available.

No specific cumulative effects to ways of life are expected if the Proposed Action or any of the action alternatives are selected.

Both the City and County would notice a decrease in the revenue base within several years if the Proposed Action is not selected because of the decrease in new housing starts, which directly affects the gross receipts tax revenues (UNM 2002). Property tax revenues would not decrease since the average price of a home would increase as demand outstrips supply (UNM 2002).

The Proposed Action and action alternatives, in conjunction with the Buckman Supplemental Wells Project, would alleviate some of the service industry and construction job layoffs for several years. In addition, both projects would add temporary jobs during the construction phase and permanent jobs during the operation and maintenance phase.

No specific cumulative effects to income are expected if the Proposed Action or any of the action alternatives are selected.

Environmental Justice

Affected Environment

U.S. Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations) directs Federal agencies to assess whether the Proposed Action or alternatives would have disproportionately high and adverse human health or environmental effects on minority and low-income populations. Identification of environmental issues can be accomplished through public involvement and the scoping process.

The formal scoping period for this project ran from July 22 through September 5, 2002. The FS and BLM invited interested parties, the public, tribal governments, and governmental agencies to comment on the Proposed Action and those issues and alternatives which should be considered. Chapter 1 contains more detailed information on the scoping process and comments.

For the purpose of this assessment, minority refers to people who classified themselves in the 2000 U.S. Census as African Americans, Asian or Pacific Islanders, American Indians, Hispanics of any race or origin, or other non-White races. A minority population refers to an area where minority individuals comprise 25 percent or more of the population. In the County of Santa Fe, persons of Hispanic or Latino origin account for 49 percent of the population, and American Indian/Alaska Natives account for 3 percent of the population. White persons, not of Hispanic or Latino origin, accounted for 46 percent of the total County population in 2000 (Census Bureau 2002).

Low-income population refers to a community in which 25 percent or more of the population is characterized as living in poverty, as determined by statistical poverty thresholds used by the United States. In 2000, the poverty weighted average threshold for a family of four was $7,603, and $8,794 for an unrelated individual (Census Bureau, 2000b). In the County of Santa Fe, 11.9 percent of the population is below the poverty threshold (Census Bureau 2002).

Field investigations of the project area indicate that the proposed water diversion site and the Buckman/Dead Dog Leg corridors are located primarily within FS and BLM rangelands that do not contain residential communities. Reservation lands of the Pueblo of San Ildefonso are directly across the Rio Grande from the proposed water diversion site. These tribal lands are not residential but support the cultural practices of the pueblo.

Environmental Consequences

During the EIS process, public input from persons or groups was considered regardless of their demographic or socioeconomic characteristics. Based on public comment and the EIS analysis, the FS and BLM determined that the issues associated with environmental justice would not be affected by the Proposed Action or any of the action alternatives.

No Action Alternative

If the No Action Alternative is selected, water availability may be severely limited, potentially leading to an increase in housing costs, both purchase and rental, as construction of new homes declines but demand stays the same or increases slightly (UNM 2002). It is impossible to predict the price point at which local workers would no longer be able to afford housing or when

employment opportunities would be lost. The majority of workers in the service industry are in the lower income brackets and many would be faced with the predicament of not being able to afford housing in the region. Many low-income residents would leave the area in order to find affordable housing. State government workers would be affected as well because their incomes would not cover the cost of housing if large price increases accompany a decreasing supply. In addition, construction and service industry jobs may be lost because of the lack of development and decrease in tourism.

Direct and Indirect Effects of the Proposed Action

Construction Effects. Construction jobs would be created during the construction of the project that may alleviate some job loses that may have occurred from slowdowns in home building or industries during recent droughts.

Operation Effects. The effects to environmental justice would be similar to the No Action Alternative for the operational phase. There are no communities or housing within the construction area and no minority or low-income populations. Direct effects to minority or low-income groups are difficult to identify as exclusively affecting these groups. Even though Native Americans constitute a minority population in the County of Santa Fe, the population is dispersed throughout the County. The water that would be available because of the diversion would be available equally to all residents with municipal or County hookups. The FS initiated ongoing consultations with the following tribes: Pueblo of Jemez, Navajo Nation, Pueblo of Laguna, Pueblo of Acoma, Pueblo of San Juan, Pueblo of San Ildefonso, Pueblo of Santo Domingo, Pueblo of Isleta, Pueblo of Taos, Pueblo of Picuris, Pueblo of Sandia, Pueblo of Tesuque, Pueblo of Nambe, Pueblo of Zia, Pueblo of Pojoaque, and the Jicarilla Apache Nation.

Las Campanas, a community that is generally wealthier than residents of the surrounding area, is a special use permit applicant that would pay for the water and share the cost for constructing the diversion project. However, the purchase and delivery of water to a nonminority, non-low-income group would not have a disproportionately high and adverse human health or environmental effects on minority and low-income populations.

Direct and Indirect Effects of the Sediment Facility Alternatives

No specific effects to environmental justice are expected during the construction or operation phases of any of the facility alternatives.

Direct and Indirect Effects of the Pipeline Route Alternatives

No specific effects to environmental justice are expected during the construction or operation phases of any of the pipeline alternatives.

Direct and Indirect Effects of the Power Upgrade Alternative

No specific effects to environmental justice are expected during the construction or operation phases of the power upgrade alternative.

Cumulative Effects

No specific environmental justice cumulative effects are expected because of the Proposed Action or any of the alternatives.

Unavoidable Adverse Effects

Unavoidable adverse effects are environmental consequences of an action that cannot be avoided either by changing the nature of the action or through mitigation if the action is undertaken. With implementation of the Buckman Project, unavoidable adverse effects would occur mainly on surface water resources, plant communities, animal habitat, and cultural resources. Diversion of water from the Rio Grande would unavoidably reduce the water available to downstream users for consumptive purposes. Although existing agreements allow withdrawal of water by various entities along the river, the physical reduction in the availability of water downstream from the intake structure would still be considered unavoidably adverse. Plant communities would be affected by construction activities that could result in the modification or clearing of approximately 306 acres. Fifty-nine acres would be permanently lost due to construction of facilities and associated infrastructure. Similarly, the same amount of wildlife habitat would be affected. While effects to cultural resources can be mitigated through data recovery efforts, the effect is still adverse since the resources are removed from the landscape.

Irreversible and Irretrievable Resource Commitments

Irreversible commitments are those that cannot be reversed except in the extreme long term. Irretrievable commitments of resources are expenditures or consumption of resources that cannot be reversed or restored. For the Proposed Action and alternatives, the effect to cultural resources is irretrievable. The expenditure of nonrenewable resources such as sand and other components of concrete, iron, and other metals for pipes and pumps, petroleum for the operation of heavy equipment, and labor during construction and operations and maintenance, constitute an irretrievable commitment of resources. The land proposed for permanent use (59 acres) constitutes an irreversible commitment of that resource.

Relationship Between Short-Term Use and Long-Term Productivity

Approximately 306 acres would be affected by construction of the Buckman Project with a permanent loss of 59 acres to infrastructure. The proposed mitigation measures (see the section, “Pipeline Alternatives” in Chapter 2) would return most of the affected acreage to its original biological function within a time period of several years. Productivity of the 59 acres would be lost as long as the buildings and infrastructure remain. Operation of the Buckman Project would, however, result in the long-term recovery of the aquifer in the Santa Fe Basin. This recovery of the aquifer would result in the restoration of the productivity of the aquifer, which would have a direct benefit both in the near term and to future generations.